INTERNATIONAL FOOD
POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty

Supported by the CGIAR

IFPRI Discussion Paper 00979

May 2010

Country-Level Impact of Global Recession and China's Stimulus Package

A General Equilibrium Assessment

Xinshen Diao

Yumei Zhang

Kevin Z. Chen

Development Strategy and Governance Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI) was established in 1975. IFPRI is one of 15 agricultural research centers that receive principal funding from governments, private foundations, and international and regional organizations, most of which are members of the Consultative Group on International Agricultural Research (CGIAR).

PARTNERS AND CONTRIBUTORS

IFPRI gratefully acknowledges the generous unrestricted funding from Australia, Canada, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, the Netherlands, Norway, the Philippines, South Africa, Sweden, Switzerland, the United Kingdom, the United States, and the World Bank.

AUTHORS

Xinshen Diao, International Food Policy Research Institute
Senior Research Fellow, Development Strategy and Governance Division
X.Diao@cgiar.org

Yumei Zhang, Chinese Academy of Agricltural Science
Associate Research Fellow, Agricultural Information Institute
zhangyumei2006@126.com

Kevin Z. Chen, International Food Policy Research Institute
Senior Research Fellow, Development Strategy and Governance Division
K.Chen@cgiar.org

Notices

[1] Effective January 2007, the Discussion Paper series within each division and the Director General's Office of IFPRI were merged into one IFPRI–wide Discussion Paper series. The new series begins with number 00689, reflecting the prior publication of 688 discussion papers within the dispersed series. The earlier series are available on IFPRI's website at http://www.ifpri.org/publications/results/taxonomy%3A468.

[2] IFPRI Discussion Papers contain preliminary material and research results. They have not been subject to formal external reviews managed by IFPRI's Publications Review Committee but have been reviewed by at least one internal and/or external reviewer. They are circulated in order to stimulate discussion and critical comment.

Contents

List of Tables

List of Figures

ABSTRACT

A dynamic computable general equilibrium model is developed to assess the impact of the recent global recession and the Chinese government's stimulus package on China's economic growth. The model is first used to capture the actual sector-level economic growth in 2008 and the possible economic performance in 2009 without the intervention of the Chinese government through its stimulus package. Under this global recession scenario, the GDP growth rate in 2009 falls to 2.9 percent mainly as a result of the sharp drop in exports of manufactured goods, while the agricultural sector is more crisis-resilient. Because export-oriented manufacturing sectors are often import-intensive, the weakened economy is accompanied by a reduction in Chinese firms' import demand for materials, intermediates, and capital goods. The model also shows that without government intervention, the negative effect of a one-year shock on the Chinese economy would last for many years. Also, over the next five to six years, China is unlikely to replicate its strong economic performance of the past two decades.

China's stimulus package is modeled through increased investment financed by government resources. With additional demand on investment goods, growth in the investment-related production sector is stimulated. Through the cross-sector linkages in a general equilibrium model, the demand for other noncapital goods increases, thus stimulating growth in these sectors. As production of more industrialized sectors starts to grow, so will households' income and consumption, providing market opportunities for those agricultural and service sectors that mainly produce for the domestic market.

Under the stimulus scenario, the Chinese economy is expected to grow 8–10 percent in 2009 and the succeeding years. The growth engine in this case differs from that before 2008: growth is led by domestic demand, while trade still falls significantly in 2009 (instead of the double-digit growth before 2008). Domestic demand-driven stimulus growth creates jobs, and hence it increases income for both urban and rural households.

The model is also used to measure the overall gains of the stimulus package by comparing GDP between the two scenarios. Without considering the productivity-enhancing role of public investment as part of the stimulus package (which is important for long-term growth but unlikely to happen in the short run), the cumulative difference of the GDP between the two scenarios over the next seven years is about RMB76 trillion, which is about three times more than the GDP in 2007.

Keywords: global financial crisis, China stimulus package, general equilibrium modeling

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
CES	constant elasticity of substitution
CGE	computable general equilibrium
CPI	consumer price index
DCGE	dynamic computable general equilibrium
FDI	foreign direct investment
GDP	gross domestic product
GIMF	global integrated monetary and fiscal model
IMF	International Monetary Fund
IO	Input-output model
ODI	Overseas Development Institute
RMB	renmimbi (Chinese currency)
SAM	social accounting matrix
TFP	total factor productivity
WTO	World Trade Organization
Y	yuan, the primary unit of Chinese currency

1. INTRODUCTION

The world economy is going through its worst recession since the Great Depression in the 1930s. The 2008 financial crisis that started in the United States and some European developed countries quickly spread around the world, affecting almost all developed and developing countries. While some early signs seem to indicate that the financial crisis is over, economic recovery has a long way to go. The world economy continues to decline and the high unemployment rates in many countries are not expected to fall any time soon. The International Monetary Fund (IMF 2009a) predicted that the global GDP growth rate would be negative (-1.4 percent) in 2009, and the World Bank estimated that the number of poor people would increase by 53 million (Chen and Ravallion 2009).

As one of the world's largest exporting countries, China's economy has been hit by the global recession that caused a big slump in many developed countries' import demand for Chinese goods. Also, because China is the world's third largest importing country, such diminished global export demand for Chinese goods sharply reduced China's demand for raw material imports from developing countries and for intermediates and capital goods from the developed countries. Obviously, the Chinese economy is highly integrated with the world economy and measures taken by the Chinese government during the crisis will not only affect China's economy but also the global recovery process.

China is one of the few countries to respond early and quickly to the crisis. Not only is the size of China's stimulus package of 4 trillion yuan (Y) (about US$600 billion) one of the largest in the world, the Chinese government has also adjusted its macroeconomic policies as part of its strategic response to the crisis. China's quick action and its sizable stimulus package also seems to have had an effect earlier than those adopted by other countries, since Chinese GDP growth started to recover during the second and third quarters of 2009. Accordingly, many international organizations and financial institutions have adjusted their projections about China's growth rate in 2009 and 2010. China has also increased its own growth projection to more than 8 percent for 2009 and 9 percent for 2010 (Chinese Academy of Social Sciences 2009).

While China's early recovery has attracted ample attention from media, business circles, and politicians around the world, only a few studies have looked into the financial crisis in China. The World Bank, International Monetary Fund (IMF), Asian Development Bank (ADB), and other international organizations have carried out a number of studies on the impacts of the financial crisis on developing countries, but none of them included China. The Overseas Development Institute (ODI) summarized the impact of the financial crisis on 10 developing countries but only provided a brief description of China's policies for dealing with the financial crisis and a short discussion about the implications for other developing countries (Mareike and Kennan 2009). In China, while quite a few initiatives have been launched to examine the effects of the global recession and the government's measures to alleviate it on different sectors of China's economy, few have been published. Wang and Cai (2009), for example, analyzed the impacts of the world financial crisis on domestic employment in China and discussed necessary coping measures. The Development Research Center of State Council (2009) synthesized the Chinese government's measures in response to financial crisis and evaluated their effects.

Aside from these descriptive studies focusing on the short-run impacts of the financial crisis, a few quantitative analyses have been published recently. He, Zhang, and Zhang (2009), for example, assessed the effect of China's stimulus package on output and employment based on two independent models, an input-output (IO) model and the Global Integrated Monetary and Fiscal (GIMF) model calibrated to China. While the IO analysis considers the structure of the Chinese economy and includes 17 production sectors, a linear IO model with fixed input-output coefficients, fixed prices, and perfectly elastic supply often exaggerates the size of intersectoral linkages resulting in unrealistic multipliers (Haggblade, Hammer, and Hazell 1991). Although the GIMF is a dynamic general equilibrium model applied independently of the IO model exercise, it focuses on the aggregated economy without taking into consideration intersectoral linkages. Liu (2009), on the other hand, conducted a structural vector autoregression analysis to quantify the impact of global financial crisis on China using recent data—up to

2008. While the results of such an exercise indicate the sizable impact of the decline in the economic growth of the United States, the European Union and Japan on the Chinese economy, it is unable to assess the possible effects of China's stimulus package.

The objective of this paper is to examine quantitatively both the effect of the recent global recession and the Chinese government stimulus packages on China's economy in the short- and medium-terms. A dynamic computable general equilibrium (DCGE) model is developed for China and applied in the study. The study finds that China's economy could have been more negatively affected by the global recession than actually occurred in late 2008 and early 2009, and the decline in growth from the recession could have lasted for many years without the introduction of the stimulus package in early 2009. The stimulus package has not only allowed China to avoid a continuous decline in economic growth, it has also provided China with a different engine for future growth through an enhanced domestic market. In total, the accumulative gains of China's stimulus package, measured by the increases in the country's GDP, will be about 76 trillion renminbi (RMB) over the next seven years. While this number is about three times China's 2007 GDP, it may still be an underestimated figure because the expected long-run impact of public investment on growth, through further stimulation of economic structural change and productivity increase, has actually not been taken into account in this analysis.

The paper is organized as follows. The most recent data available before and during the global financial crisis on China's economy is briefly described in Section 2. A statistical analysis of the impacts of the global financial crisis on the agricultural and rural economy is presented in Section 3 and a description of China's stimulus package in Section 4. The DCGE model developed for China is presented in Section 5. The model is initially applied to quantitatively measure the short- and medium-term impacts of global recession without the government's stimulus packages in Section 6. Then in Section 7, the stimulus packages are introduced and their potential impacts are simulated using the DCGE model. Section 8 concludes.

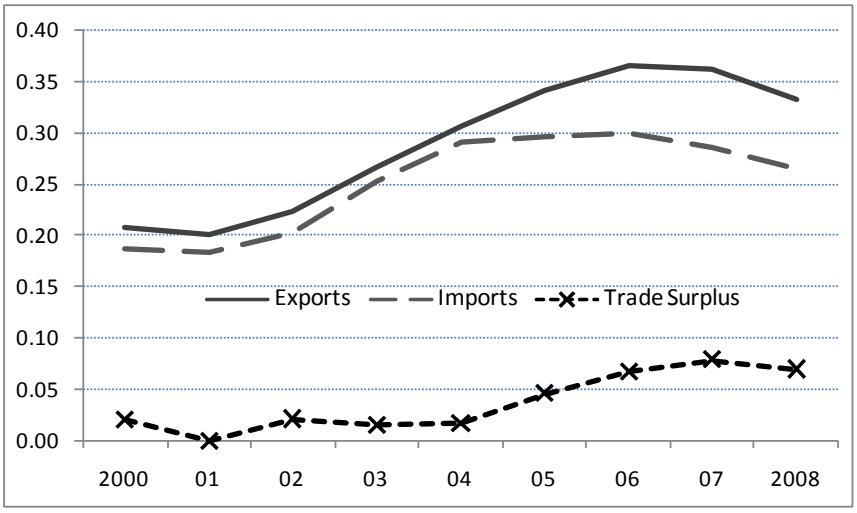
2. IMPACT CHANNEL OF THE GLOBAL FINANCIAL CRISIS ON CHINA'S ECONOMY

The recent global crisis started as a financial crisis in the United States, the United Kingdom, and some other developed countries, and it has quickly spread around the world, affecting almost all developed and developing countries. Compared with other affected countries, China's financial institutions are relatively insulated from the direct impacts of the global financial crisis. Trade and foreign investment[1] have been the main channels for transmitting the crisis to the Chinese economy, and these are the focus of the discussion in this section.

Trade

China's economy has become more integrated with the global economy since China joined the World Trade Organization (WTO) in early 2000. In 2000, the export-to-GDP ratio was 0.20, while it reached more than 0.36 during 2006–07. Similarly, the import-to-GDP ratio increased from less than 0.20 in 2000 to around 0.30 during 2006-07. Trade surplus was 8 percent of total GDP in 2007 (Figure 1). As trade has become increasingly important to China's growth, the export markets have been more concentrated in the United States, the European Union, and Japan (that is, the G-3 economies). These markets have accounted for half of total Chinese exports in recent years. Obviously, the financial crisis caused China's exports to fall immediately after the demand of the G-3 economies contracted. Moreover, characterized by the large share of processing trade, which accounted for more than half of China's total exports during 2000–07, the lower level of exports caused a big drop in China's imports, of which the lion's share is the intermediate products used in export-oriented manufacturing production. The statistics show that the growth rate of exports and imports slowed in October 2008 (-2.2 percent) and continued to be negative until November 2008 (-17.9 percent) (Figure 2). Compared with 2007, in 2008, the annual growth rate of exports and imports contracted by 8 and 2 percent, respectively. The situation did not improve in early 2009 when the monthly changes in exports and imports were reported as negative between January and August. Only recently has trade growth started to show an upward trend, compared with that in late 2008, when trade growth had already started to slow down (Figure 2 and Table A1 in the Appendix).

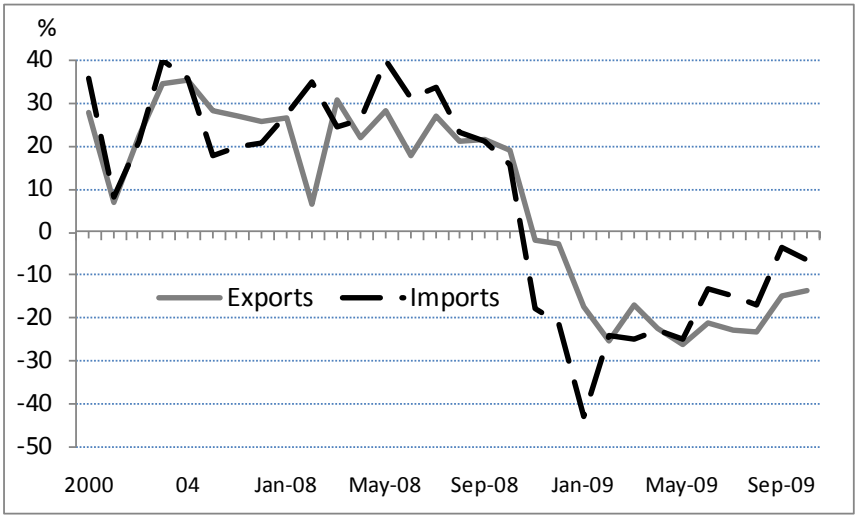
Figure 1. Ratios of trade to GDP, 2000–08



Source: NBS 2009a.

[1] The total value of overseas remittances received by China was only US$46 billion in 2008, equivalent to less than 50 percent of foreign direct investment and about 10 percent of trade surplus in the same year (NBS 2009a)

Figure 2. Growth rate of total exports and imports (%), 2000–09



Source: China Custom Statistics 2009.

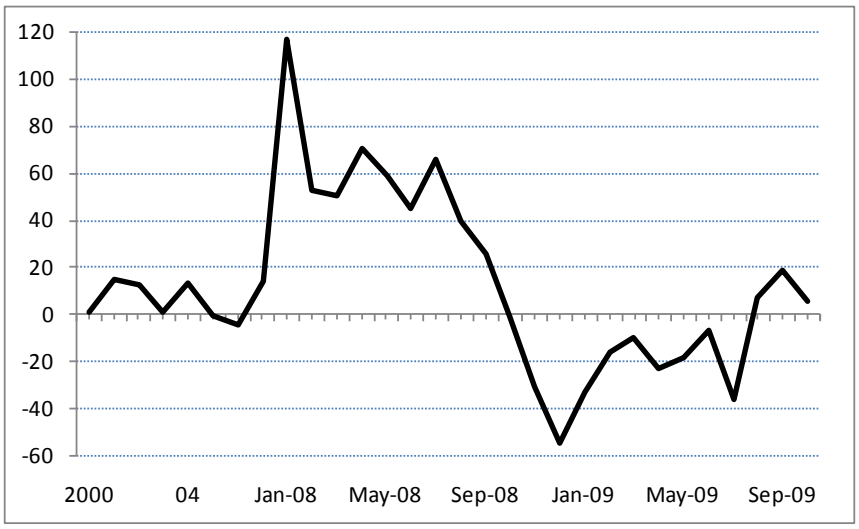
The lower export demand was quickly transmitted to the domestic economy because many Chinese firms heavily depend on the export markets for operation. Many of these firms started to lose profits and ran into bankruptcy or temporary shutdowns due to the sharp decline of foreign orders. Economic theory implies that when firms are struggling to continue their operation, they have to start laying off workers, which leads to high unemployment and lowered wage income. The income effect will then transmit to a consumption effect because many affected families have to cut their spending. Obviously, the general equilibrium linkage of trade with the whole economy is complicated, and a full assessment of the trade transmission channel mechanism requires a structural analysis that will be conducted in later chapters of this paper.

Foreign Direct Investment (FDI) Channel

China has one of the most favorable investment environments in the world, with FDI reaching US$92 billion in 2008.[2] While the ratio of FDI to GDP (less than 5 percent) or to total investment (less than 10 percent) has not been high in recent years, given the rapidly growing size of the Chinese economy, FDI has played an important role in helping China expand and diversify its export markets. The FDI inflows were stable before 2008 but increased suddenly in January 2008. The global financial crisis, however, reversed this trend after October 2008, and the negative growth in early 2009 contrasted sharply with the 20–60 percent growth experienced between 2007 and early 2008 (Figure 3 and Table A1 in the Appendix). Similar to trade, the FDI also affects the economy through complicated interactions. Moreover, trade and FDI are interrelated. For example, foreign companies operating in China and producing for the global market are affected by a slowdown in exports and thus have to postpone their investment plans, causing a reduction in FDI. But the drop in FDI also lowers demand for imported equipment and other construction-related domestic products, which creates a second round of effects to the economy.

[2] With exchange rate of US$1 = 7.8 Yuan, it is equivalent to 7,200 billion Yuan in 2008.

Figure 3. Foreign direct investment growth rate (%), 2000–09



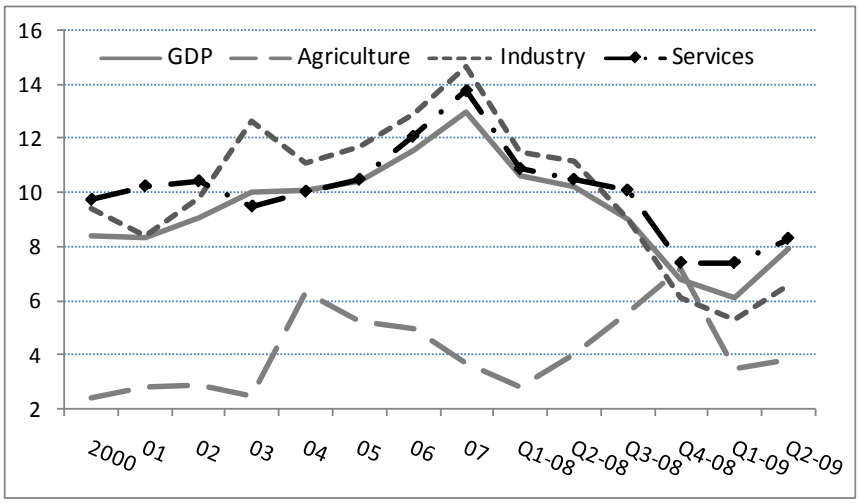
Source: Ministry of Commerce 2009.

Gross Domestic Product (GDP)

China' GDP in real terms registered double-digit growth between 2003 and 2007, and the growth rate reached as high as 13 percent in 2007 (Figure 4 and Appendix Table A.1). Growth started to slow in the second half of 2008 and continued into the first quarter of 2009. From being more than 10 percent in previous years, the GDP growth rate in the fourth quarter of 2008 declined to 6.8 percent, the lowest annual growth rate since 2003. With the global recession deepening, the GDP growth rate further dropped to only 6.1 percent in the first quarter of 2009. The economy started to recover in the second quarter of 2009 and growth rates rebounded to 7.9 in the second quarter and to 8.9 percent in the third quarter, which seems to show that China's stimulus packages have had a positive effect.

The global recession affects sector growth differently. Agriculture appears to have been more resistant to the shock, while the industrial sector was hit the hardest. The share of agriculture in the economy has declined over the last two decades and has been only about 10 percent in recent years. But after stagnant growth in the late 1990s and early 2000s, China's agricultural sector managed to grow more than 5 percent between 2004 and 2006 and approximately 4 percent in 2007. In 2008, agriculture continued to grow rapidly at 5.5 percent. Moreover, the slowdown in agricultural growth in the first two quarters of 2009 was modest and did not significantly deviate from its recent trend. On the other hand, growth in the industrial sector declined from 14.5 percent in 2007 to 9.3 percent in 2008 and to 5.3 and 6.6 percent in the first two quarters of 2009. It is interesting to note that the growth rate of agricultural GDP was faster than that of industrial GDP and almost caught up with the growth rate of the service sectors in the fourth quarter of 2008. Hence, the growth of agriculture played a special role in mitigating the adverse impacts of the economic recession.

Figure 4. Growth rate in GDP and sectoral GDP (%), 2000–09



Source: Data of 2000-2007 are from NBS 2009a and for 2008-2009 are from NBS 2009b.

Employment

China's economically active population was about 792 million by the end of 2008, of which about 775 million were considered to be employed. Nearly 40 percent of employees were engaged in the agricultural sector, while about 27 and 33 percent were involved in the industrial and service sectors, respectively. China's unemployment data only includes registered and nonregistered unemployment, while the layoffs of rural off-farm laborers are not counted. As a result, the registered unemployment rate in urban areas is expected to be lower than the actual unemployment rate. While the registered unemployment rate only slightly increased from 4.0 percent in 2007 to 4.2 percent in 2008 and then to 4.3 percent in the first half year of 2009, those are the highest rates since 2003.

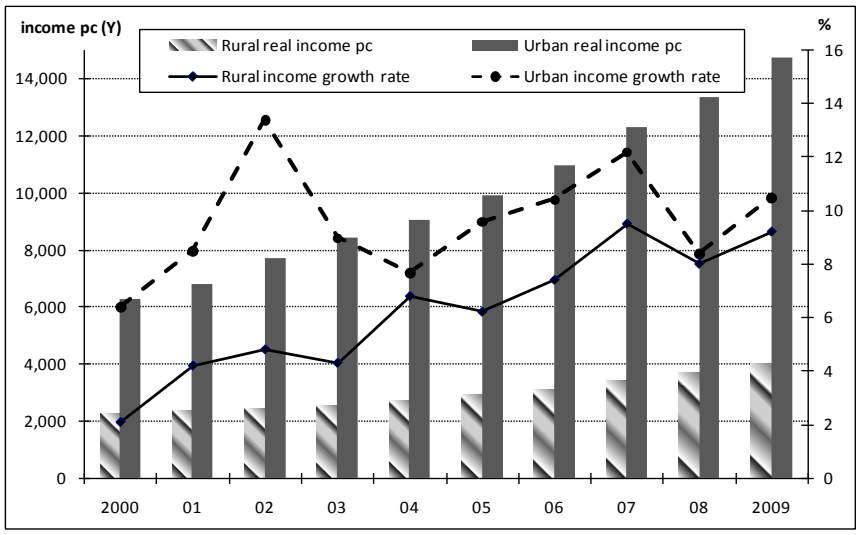
The financial crisis also affected rural employment, according to evidence from various sources. A survey conducted by the Ministry of Agriculture in late 2008 (Chen 2009) revealed that about 20 million workers returned from urban areas to their hometowns in rural areas in recent months due to job losses. In most cases, lost jobs were those with low skill requirements, which were usually held by rural migrants. As a consequence, rural migrants were affected the most. At the same time, it is believed that about two-thirds of the textile enterprises were operating at a profit loss and started to lay off workers during the crisis (China National Textile and Apparel Council 2009). Recently, the employment situation has started to improve along with the economic recovery that has already started in the country.

Household Incomes

The growth rate of household income has almost recovered to its pre-crisis level. According to recent Chinese statistics, per capita disposable incomes of urban and rural households in the first three quarters of 2009 were Y12,973 and Y4,307, respectively— 10.5 and 9.2 percentage points higher than those in the same period of 2008. The urban and rural household incomes in 2008 were adversely affected by the crisis and only grew 8.4 percent and 8.0 percent, respectively, 3.8 and 1.5 percentage points lower than those in 2007 (Figure 5). Changes in the income growth rate suggest that urban households were affected more than rural households. However, it is possible that both rural and urban households' incomes were overestimated. This is because the official statistics on urban households only include income from formal jobs that were less affected by the crisis (NBS 2009c), while the rural households' remittance income received from family members working in the urban areas may have been underestimated in the

previous years. Omission of informal job earnings may mask the effects of the crisis for both rural and urban households whose main income source is the provision of low-skilled labor to informal jobs.

Figure 5. Rural and urban per capita real income and income growth rate, 2000-09

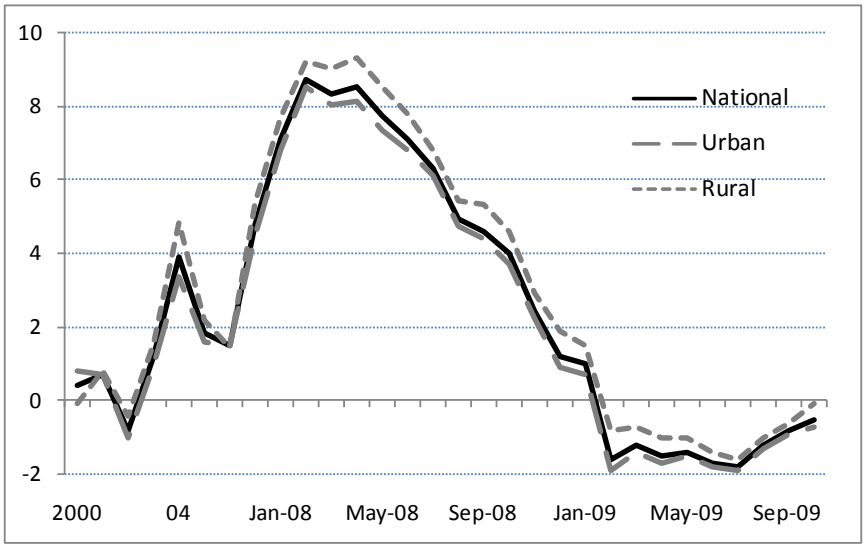


Source: Data of 2000-2008 are from NBS 2009a and for 2009 are from NBS 2009d.
Notes: For the urban households the income is annual disposable income, while for the rural households it is annual net income.

Consumer Price Index (CPI)

The CPI rose steadily during 2000–08, except in 2002 when it declined by 0.8 percent. The annual change in the CPI was less than 5 percent during 2000–07 and near 6 percent in 2008. Since February 2009, change in the CPI became negative, although the downward trend has slowed after August 2009 (Figure 6).

Figure 6. Change in consumer price index (CPI), 2000–09



Source: Data of 2000-2007 are from NBS 2009a and for 2008-2009 are from NBS 2009e.

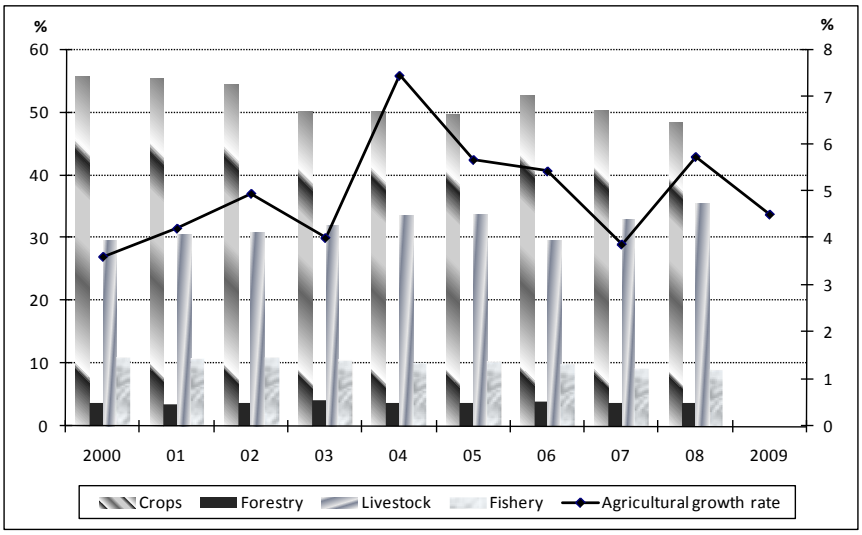
3. THE AGRICULTURAL SECTOR AND RURAL ECONOMY

As pointed out in the earlier discussion, agriculture seems to have been more resilient than the industrial and service sectors during the crisis. Since many rural migrants returned home during the crisis, the agricultural sector has actually played a role in social and economic stabilization. Moreover, because rural households spend a relatively larger portion of income on goods and services produced domestically than urban households do, and because the rural population is still larger than the urban population in China, agricultural and rural development can potentially support domestic market-driven growth. The impacts of the crisis on agricultural output, trade, price, rural employment, and rural income are presented below.

Agricultural Output

Crop production constitutes almost half of the agricultural GDP in China, while the other half is a combination of livestock (accounting for 35 percent), fishery, and forestry (Figure 7). Measured by the gross output value, growth in China's crop production was slow before 2004. The low agricultural growth shows that China was losing its comparative advantage in crop production from many aspects due to scarcity of land resources and competition from the nonagricultural sector for land, labor, and capital. In recent years, a series of agricultural support policies, including elimination of agricultural taxes and provision of various subsidies, have been implemented in order to stimulate agricultural growth. Farmers responded to these policies positively: crop production growth was 7.5 percent in 2004 and growth rates of 4–5 percent were recorded from then until 2008 (Figure 7). The growth rate of crop production in the first three quarters of 2009 was 3.7 percent, which, when compared with that in the same period of 2008, was only slightly lower than the average level during 2005–08. Livestock grew more rapidly than crop production due to strong demand-side effects. Between 2000 and 2008, the livestock annual growth rate was 6–8 percent except for 2007. However, growth declined to 5.3 percent in the first three quarters of 2009, which is 1.5 percent lower than that of 2008. In total, agricultural output's growth rate of 4.5 percent in the first three quarters of 2009 was comparable to that of 2008, though it was slightly lower than the annual growth rate of 5.7 percent in 2008.

Figure 7. Shares of crops, livestock, fishery and forestry in agricultural GDP (2000–08) and agricultural GDP annual growth rate (2000-09)

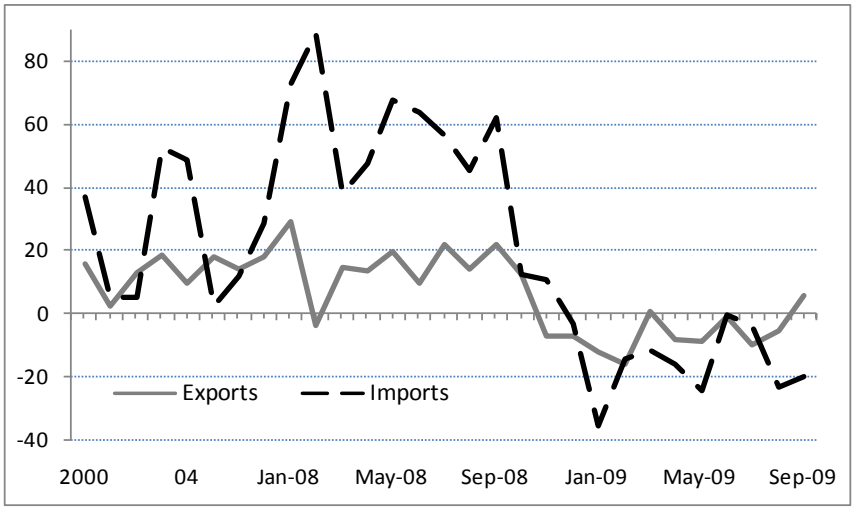


Source: Data of 2000-2008 are from NBS 2009a and for 2009 are from NBS 2009b.
Note: The 2009 annual growth rate in agricultural GDP is based on the first three quarters' data.

Agricultural Trade

According to the Ministry of Agriculture (2009), China's agricultural exports and imports in 2008 were valued at US$40.5 and US$58.7 billion, respectively, and quantitatively, there were more imports than exports. The annual growth of agricultural exports slowed to 9.4 percent in 2008, from a range of 14–18 percent during 2005–07. However, imports grew by 42.8 percent in 2008. Similar to the overall trade situation, agricultural trade growth has slowed since October 2008, turning negative in November 2008 for agricultural exports and in December 2008 for agricultural imports (Figure 8). In the first nine months of 2009, the monthly growth in agricultural exports and imports continued to be negative, except for agricultural exports in September 2009 when modest positive growth was seen.

Figure 8. Growth in agricultural exports and imports (%), 2000-09

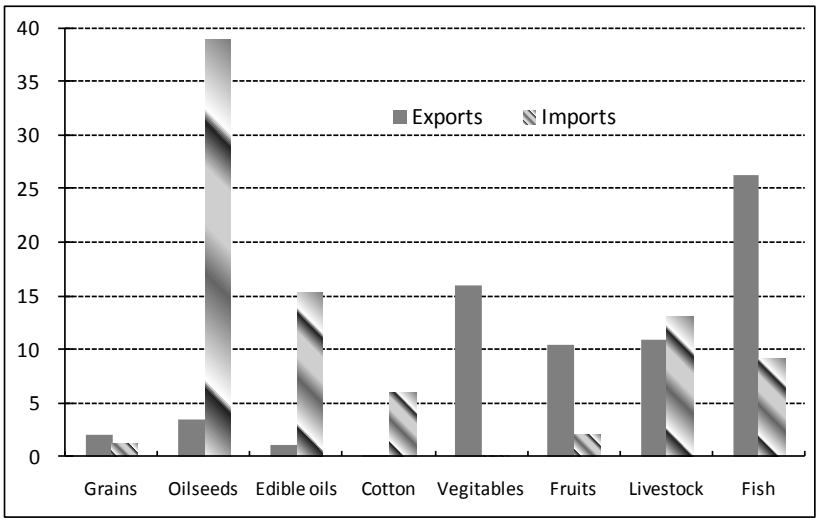


Source: Ministry of Agriculture 2009.

Since 2000, China's top four agricultural export products have been fish, vegetables, fruits, and livestock products. With 26–30 percent of agricultural exports being fishery products, the fishery sector was the most important agricultural export sector between 2000 and 2008, followed by vegetable exports, accounting for 13–16 percent of total agricultural exports. While livestock exports tend to be ranked second in terms of agricultural total exports, the share of livestock exports declined to about 10 percent in the last two years and became comparable to fruit exports, which used to be a less important export category. In total, these top four export products account for more than 60 percent of Chinese agricultural exports.

On the import side, more than one-third of agricultural imports are oilseeds (dominated by soybeans) and edible vegetable oil (dominated by palm oil); their share in total agricultural imports reached more than 50 percent in 2008, led by increased soybean imports. Fish and livestock are not only important export products but also account for a relatively large share of imports. The other important import product is cotton, which accounted for 6–15 percent of total agricultural imports during 2000–08. Both the import and export shares of grain in China's total agricultural trade are very small (less than 2 percent in 2008) (Figure 9). Similar to the effect of the financial crisis on total agricultural trade, exports of these products declined significantly. For example, in the first three quarters of 2009, exports of fruits and livestock products decreased by 15 and 13 percent, respectively, from their 2008 level in the same period. Similarly, the growth rate in vegetable exports slowed in the period. The value of agricultural imports declined even more, and imports of oilseeds, edible oil, and livestock products dropped 15–21 percent.

Figure 9. Share of total agricultural exports and imports for selected products, 2008

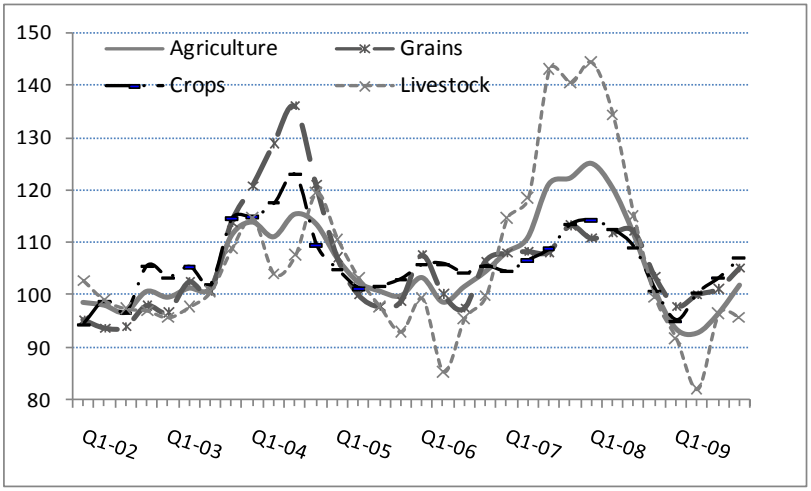


Source: Ministry of Agriculture 2009.

Agricultural Prices

The movement of the agricultural product price index in China did not fully follow the movement of world food price. Compared with the previous years, a significant increase in agricultural prices in 2007 and early 2008 is consistent with the hike in CPI presented in Figure 5. China registered its highest economic growth in 2007 (more than 13 percent), and rapidly increasing investment demand led to the highest inflation rate in 2007. Although the government of China imposed a series of inflation control measures, particularly on food prices, increased global agricultural prices meant that many measures could not effectively influence the movement of domestic prices immediately. The measures controlling domestic food prices seem to show their effects in the middle of 2008, when global food prices were still high. The further decline in agricultural prices at the end of 2008 and early 2009 also reflects the impact of the global financial crisis, which causes world agricultural prices to fall from the peak in early 2008 (Figure 10).

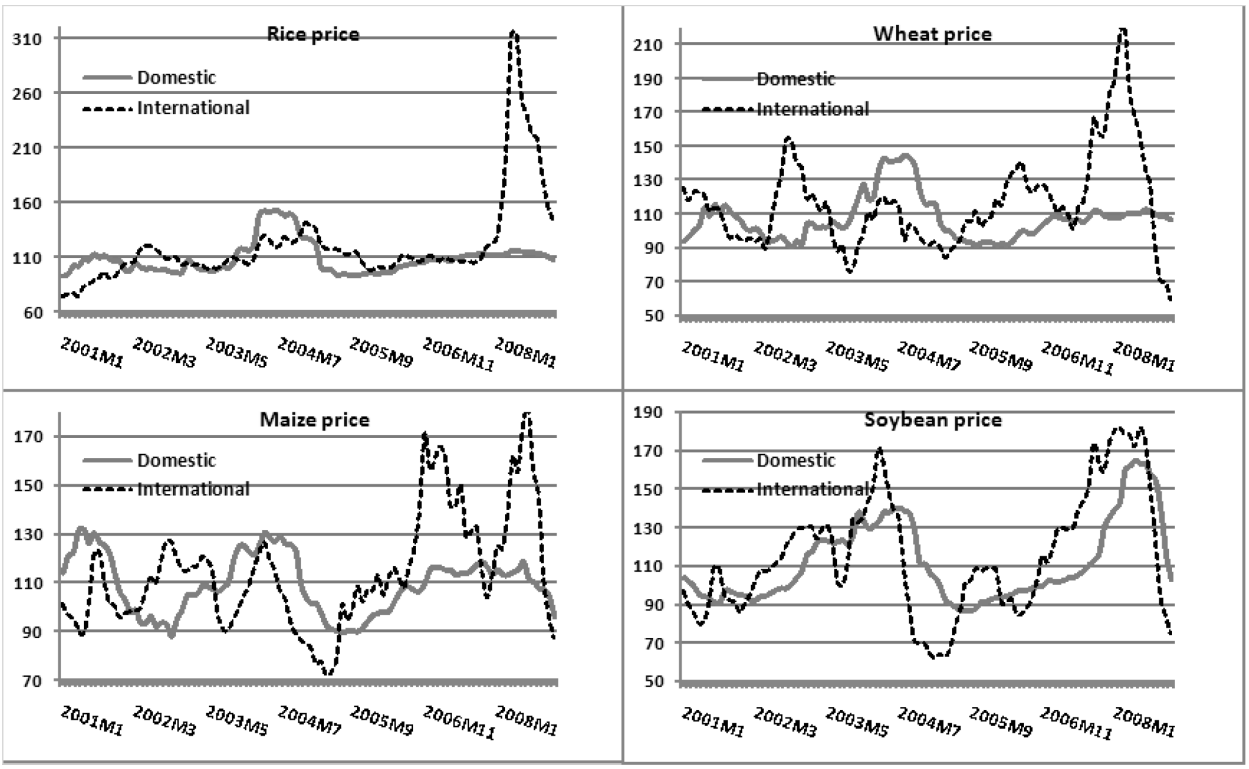
Figure 10. Agricultural producer price indexes (previous year's same quarter=100), 2000-09



Source: Development Research Center of the State Council Statistical Database System website.

We also compare domestic and international price movement of selected four agricultural products, rice, wheat, maize and soybeans in Figure 11. While global food price crisis was characterized by the price hike in these four commodities in the world market, their price movements in China's domestic markets are not necessarily the same as that in the world market. Increases in China's domestic prices for rice, wheat and maize were relatively modest in the early 2008 and thus a significantly departure from international price movement has been observed. On the other hand, domestic price for soybean follows closely with the change in its international price and registered a big hike in early 2008. Trade dependency ratio seems to be a main reason to explain such different movements between prices for grain products and for soybeans, given that more than 60 percent of soybean consumed in China is imported, while imports account for less than one percent of domestic consumption in the case of the three grain products.

Figure 11. Selected agricultural product prices, domestic and international (previous year's same month=100), 2001-08



Source: International price is from IMF 2009b and domestic price is from Development Research Center of the State Council Statistical Database System website.

Off-Farm Employment

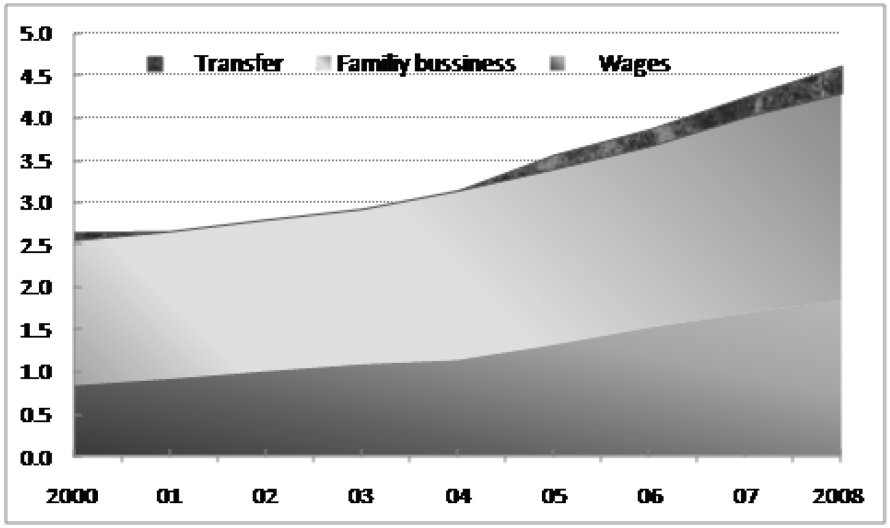
According to a recent off-farm worker survey conducted by the National Bureau of Statistics (2009b), there were about 140 million rural migrants working outside their home towns by the end of 2008. About 50 percent of them (70 million) went back home during the Chinese Spring Festival season in January of 2009. However, among these 70 million, 20 percent did not return to the cities where they used to work but stayed at home to find jobs. Of the 80 percent who did return to cities, 11 million actually did not find jobs. Another survey, covering 120 villages in 11 provinces, was conducted by the Rural Economy Research Center of the Ministry of Agriculture in late 2008, and it shows that in October 2008 about 6.5 percent of migrant workers went back home due to job loss (Wang and Cai 2009). Based on a survey

conducted in the six provinces, Huang et al. (2009) estimate that 45.4 million rural migrant workers were laid off between September 2008 and April 2009, of which about half eventually found new jobs. The estimated net loss of jobs in April 2009 was about 20 million—that is 3.8 percent of the total rural labor force—while 30 percent of the 20 million migrant workers found jobs later (between May and August of 2009). This study also shows that the older or less educated workers were hurt more than the younger or more educated ones, who were able to find jobs quicker. A recent off-farm worker survey conducted by the National Bureau of Statistics shows that the employment of migrant rural labor increased by 3.8 million in the second quarter of 2009, up 2.6 percent from the first quarter of 2009 (NBS 2009f). More than 1.01 million people were employed in the third quarter, 0.7 percent more than in the second quarter of 2009 (NBS2009g).

Rural Income

China's rural household income is lower than that for urban households, and growth in rural household income is also slower (Figure 5). Although wage income earned from off-farm jobs grew rapidly, it accounted for about 40 percent of per capita net income for the rural households as a whole in 2008, up from 30 percent in the early 2000s (Figure 12). In the first three quarters of 2009, rural households' net income increased by 9.2 percent, which was slightly higher than the average growth rate in the previous years. While family business (including agriculture) was the largest source of net income of rural households, it was affected more adversely by the crisis. The income growth for family business was only 4.0 percent in the first three quarters of 2009 (NBS 2009d), while the growth rate was 8.4 percent in 2007 (Figure 12). Another income source that should be noticed is direct transfer through various government agricultural subsidy programs. While such income accounts for a small part of total household income, it has grown very rapidly in recent years— 37 percent in 2008 and 27 percent in the first three quarters of 2009.

Figure 12. Rural per capita annual real income at 2008 constant prices (1,000 Yuan)



Source: NBS (various years).

4. STIMULUS PACKAGE: POLICIES AND INVESTMENTS

The current global recession is the most serious economic crisis the world has faced since World War II, and it is also the first serious challenge to China's growth miracle of the past two to three decades. The eyes of the world are on China, not only because of the size of her economy, but also the speed of the changes that have occurred in the country. In the late 1990s the Asian financial crisis brought a sudden halt to the growth miracle in some Asian tiger economies. Will China's growth miracle face a similar outcome as a result of the current crisis? The slowdown in growth challenges the Chinese government economically and politically. Social instability as an outcome of mass unemployment and a continuously widening income gap between the rich and the poor have been experienced by some developing countries when growth has suddenly disappeared.

Policy Adjustments

To avoid a rapid increase in unemployment and to maintain social stability, the Chinese government responded quickly to the crisis by making a series of adjustments to its macroeconomic policies, moving from the tight fiscal policy adopted in early 2008 to a loose one and adopting an accommodating monetary policy. Given the slowdown in growth of the world economy and the sharp decline in export demand, the Chinese government adopted a fundamental approach to increase domestic demand, including expansion of public investment and promotion of private consumption through sizable fiscal supports and improvement in people's lives through infrastructure and post disaster (earthquake) reconstruction. In addition, a wide range of monetary policy instruments have been employed to maintain sufficient liquidity of the banking system and to stabilize the exchange rate.

Of all the interventions, the fiscal stimulus package of Y4 trillion (equivalent to US$586 billion) is the key measure for coping with the crisis. The package, equivalent to about 16 percent of China’s GDP in 2007, was announced by the government in November 2008 and implemented by the end of 2008; it is expected to continue through 2010. In the package, Y1.2 trillion (about US$170 billion), or 29.5 percent of the total, will be provided financially by the central government, while the remaining will be funded by local government budgets, banking loans, or provided through other financial channels. In order to help the provincial governments to better finance related investment, the State Council approved the Ministry of Finance, on behalf of the provincial governments, to issue additional treasury bonds valued at Y200 billion.

In terms of the central government's Y1.2 trillion, the first Y100 billion was invested by the end of 2008; the other Y500 billion was planned for 2009, while the remaining Y600 billion will be invested in 2010 (see the investment portfolio of the stimulus package in Table 1). The government has also earmarked Y1 trillion, or 25 percent of the package, for post earthquake reconstruction in southwestern Sichuan Province. Affordable housing construction for the affected residents will cost Y400 billion, public utilities in rural areas and industry restructuring will be Y370 billion each, while Y210 billion will be deployed to fund eco-friendly and energy-saving projects. The remaining Y150 million will be used for health care and education (NDRC 2009). Agriculture, rural areas, and farmers are among the top priorities of the package to increase rural incomes that provide an important means for expanding domestic demand. The stimulus package also attempts to address China’s income inequality, in particular rural-urban income inequality (Liu 2009).

Several tax-related policy reforms were adopted to enhance the competitiveness of enterprises and to increase household incomes. The main tax policies include a measure to implement a new law of enterprise taxes and to raise the minimum deduction level for personal income taxes. In total, a tax burden of Y280 billion on enterprises and households was reduced in the last quarter of 2008. A comprehensive reform of the value added tax is also a part of the new enterprise tax reform. Moreover, the government will continue the favorable tax reduction and export tax rebate policies for small and medium enterprises, real estate, and the stock exchange. The government also plans to reduce and eliminate unnecessary administrative fees, and it was reported that about 100 such fees will be eliminated. As a result, it is

expected that about Y500 billion in taxes or fees paid by firms and individuals will be cut in 2009. To support the development of export-oriented, high-tech manufacturing sectors, some relevant sectors will receive more export tax rebates.

Table 1. Investment portfolio of China's stimulus package for the central government (Y100 million)

Item	Total investment	% of specific investment	2008-09 investment from central government	2009 investment from central government	2010 investment from central government
Total	**40,000**	**100**	**5,915**	**4,875**	**5,885**
Civilian projects	4,000	10	522	422	
Rural civilian projects	3,700	9.3	1,253	913	
Infrastructure	15,000	37.5	460	210	
Social welfare	1,500	3.8	703	573	
Sustainable environment	2,100	5.3	260	140	
Technology advances and industry restructuring	3,700	9.3	585	525	
Post earthquake reconstruction	10,000	25	2,000	2,000	
Other			132	132	

Source: NDRC 2008 and 2009, Ministry of Finance 2009.

Social Security and Employment Benefits

Improving the social security system and employment benefits is seen as an important measure to boost consumers' confidence and to expand domestic demand during the global recession. Under the stimulus package, the Chinese government spent Y270 billion on social security and employment benefits in 2008, 19.2 percent more than they spent in 2007. The budget for social security and employment benefits was Y330 billion in 2009, up 22 percent from 2008. In particular, rural and urban household social security was reinforced. The fiscal support was increased to improve the standard of the minimum retirement pension, with special subsidies to western, central, and northeastern regions. In 2009, 10 percent of counties were selected to implement a new rural social retirement pension plan. The subsidy covers part of the premiums paid by the rural residents. In certain situations, the subsidy also covers part of the pension payment. In the western region (one of the largest lagging regions in China), the central government now covers the full cost of the new social retirement pensions, while in the other regions, the subsidy is only about 50 percent. The total subsidy is equivalent to Y55 per person per month.

Industry Development Strategy

To improve competitiveness and to develop new industries with advanced technology, the Chinese government launched an industry development strategy in early 2009 to target 10 main manufacturing sectors. These sectors include automobiles, steel, shipbuilding, petroleum chemistry, light manufacturing, textiles, machinery, and information technology. The strategy encourages investment in the adoption of new technology, including eco-friendly and energy-saving technologies, and provides financial incentives. For this purpose, Y370 billion is allocated to investment in industrial upgrading and Y150 billion to research and technology development. A reform to introduce cost recovery of natural resource use in order to protect the environment has been considered, as well as improvements in resource use taxation.

Monetary Policy

The Chinese government has adjusted its policy objective from controlling inflation to stimulating economic growth. It also changed its monetary policy from the prudent one adopted in early 2008 to a moderately loose one in September 2008. Prime rates of deposit and credit were adjusted downward five times. At the same time, credit control measures were removed to induce financial institutes to increase their credit supply to the priority areas identified by the stimulus package, such as agricultural and rural development, small- and medium-sized enterprise financing, and recovery in the earthquake disaster areas. To support the real estate market, the loan rates for commercial and personal houses and the down payment rate were adjusted downward.

Pro-Agricultural and Rural Economic Policies

More than half of Chinese still live in rural areas, and the level of rural households' income and consumption is still much lower than that of urban households. In recent years, especially since 2004, the central government has increased investment support in agricultural and rural development and increased direct transfers to rural households. The total central government expenditure to support agricultural and rural development was only about Y200 billion in 2003. It has increased rapidly, however, reaching about Y600 billion in 2008, up 37 percent over 2007 and Y720 billion in 2009. The average annual nominal growth rate was about 22 percent during 2003–09. Many measures have been taken to increase personal income and boost consumption. The main measures are enhancing public infrastructure investment and agricultural subsidies and reforming education, medical health, and social security.

Agricultural Infrastructure

Expenditures for developing agricultural infrastructure total Y113.76 billion and are mainly being used for water, electricity, roads, gas, and housing. The total investment in agricultural infrastructure rose to Y344.7 billion in 2009, an increase of about 28 percent.

Farmers' Subsidies

To support agricultural production, especially grain production, four kinds of subsidies have been provided to farmers in recent years, including direct subsidies to grain producers, subsidies for the use of superior seed varieties, subsidies for agricultural machines and tools, and subsidies for agricultural input. Agricultural subsidy expenditure totaled about Y103 billion in 2008 and Y123 billion in 2009. Subsidies for the use of superior seed varieties have been increased and subsidy levels have been raised; subsidies are available to all rice, wheat, corn, and cotton growers and have been extended more widely to canola and soybean farmers. A new subsidy on tea-oil tree planting has been introduced. The central government is spending Y13 billion, a year-on-year increase of Y9 billion, on subsidies for purchasing agricultural machinery and tools. General subsidies for agricultural supplies are being increased to coordinate with price rises and changes in the acreage planted in various crops.

Farm Product Price Stabilization

To protect farmers from the possible impact of the global recession, a combination of control policies has been introduced, including raising purchase price floors, manipulating reserves, temporary purchasing and stockpiling, shipping to other regions, and exporting and importing. These steps were taken to stabilize the prices of major agricultural products such as grain, edible vegetable oil, cotton, sugar, and hogs. In 2009, the minimum purchase price of wheat was raised byY0.22 per kilogram and rice by Y0.26.

Agricultural Insurance

Trials to subsidize insurance premiums for crops were extended from 6 provincial-level administrative areas in 2007 to 16 in 2008, covering 75 million rural households in 2008. Investments of about Y6 billion rose to Y8 billion in 2009, an increase of Y2 billion.

Agricultural Science and Technology

Investment in agricultural science and technology was raised to expand application of innovations in agricultural science and technology and provide better agriculture-related technical services.

Education

Free compulsory education is available in both urban and rural areas. Tuition and miscellaneous fees paid by all urban students receiving compulsory education was stopped in the autumn of 2008. The level of funding for operating expenses for rural compulsory education has been increased, free textbooks have been provided to rural students, and school heating subsidies for rural primary and secondary schools in northern China have been raised. In addition, new primary and secondary schools with improved sanitation facilities are being developed in the central and western regions and living facilities in rural schools there are being improved. A total of Y22.3 billion was used to grant financial assistance to students from poor families at regular undergraduate institutions, vocational colleges, and secondary vocational schools.

Medical and Health Care

A new type of cooperative medical care system has been established in all rural areas across the country, covering more than 800 million residents. The government increased the number of pilot cities making basic medical insurance available to their nonworking residents. The policy grant assistance to rural women who give birth in hospitals now covers the entire central and western regions, and the central government raised such assistance to Y300 per person for the central region and Y400 for the western region.

Employment

More jobs have been created through development of rural enterprises and model towns. Vocational education and technical training in rural areas have been increased to make it easier for rural residents to find non-farm jobs. College graduates are encouraged to work in urban and rural community-level organizations in the central and western regions and in small and medium-sized enterprises.

Rural Poverty Reduction

In 2008 a total of Y16.73 billion was disbursed to alleviate poverty through development, focusing on developing infrastructure and industry in poor rural areas and providing job training for poor rural residents. This is an increase of Y2.3 billion over 2007, rising to Y19.7 billion in 2009.

Rural Consumption Boost

At the same time, measures to stimulate rural demand and to improve rural market access conditions were adopted. There are several initiatives related to market place construction in villages or townships to extend the supply chain to cover more rural areas, to improve the provision of social services (including electrification) and consumption credits in the rural areas and to provide certain types of consumption subsidies. For example, the central government allotted Y40 billion for credit subsidies when durable consumption and investment goods are purchased by rural households. By targeting the rural markets, these measures also help urban enterprises increase sales and expand their rural markets and relevant investment.

In summary, China's stimulus package is a comprehensive one, including both investment and policy measures. While the immediate goal of the package is to stimulate domestic demand and hence to reverse the declining trend of economic growth quickly, many measures discussed above actually aim at long-run growth. This follows the traditional Chinese philosophy that a crisis is also an opportunity. China is taking advantage of this crisis to create more opportunities for sustainable growth in the long run.

5. A DYNAMIC CGE MODEL FOR CHINA

A dynamic computable general equilibrium model (DCGE) is developed for this study to assess the economic impacts of the recent global recession and China's stimulus package. As an economy-wide, general equilibrium model, the DCGE model is the proper tool for the purpose of this study, as such a model captures the economic interlinkages across sectors. A static, standard CGE model was developed in the early 2000s at the International Food Policy Research Institute (IFPRI), as documented in Lofgren, Harris, and Robinson (2001). The recursive dynamic version of the CGE model is based on this standard CGE model, with the incorporation of a series of dynamic factors. The application of similar dynamic CGE models for other country case studies can be found in Thurlow (2004), Diao et al. (2007), and Breisinger, Diao, and Thurlow (2009).[3]

Similar to other CGE models, the DCGE model is a multisectoral general equilibrium model that captures economic activities on both the supply and demand sides. On the supply side, the model has defined specific production functions for each economic activity, which is often called the production sector in the model. As in any other quantitative economic analysis, certain assumptions have to be applied before calibrating the model to the data. In a typical CGE model, a constant return to scale technology with constant elasticity of substitution (CES) between primary inputs is fundamentally a necessary assumption in order for the model to have a general equilibrium solution. However, as both primary and intermediate inputs are considered in the production functions of a CGE model, a Leontief technology with fixed input-output coefficients is often assumed for intermediate inputs as well as for the relationship between intermediates and primary inputs in aggregation.

The demand side of the CGE model is dominated by a series of consumer demand functions. In the current model, the system of consumer demand functions is solved by maximizing a Stone-Geary utility function in which the income elasticity is not necessarily one (which differs from a Cobb-Douglas utility function), and hence, the marginal budget share for each consumer good departs from the average budget share of this good in consumers' total budget. As in any other general equilibrium model, consumers' income that enters the demand system is an endogenous variable. Income generated from the primary factors employed in the production process is the dominant income source for consumers, while incomes coming from abroad (as remittance received) or the government (as direct transfers) are also considered.

The relationship between supply and demand has to be explicitly modeled in a CGE model, which determines the equilibrium prices in the domestic markets. Given that a CGE model also captures the trade flows--both imports and exports the relationship between domestic and international markets is also modeled explicitly. In general, the commodities produced or consumed in the domestic market are not perfectly substitutable for those going to or coming from international markets, and price-sensitive substitution (imperfect substitution) between foreign goods and domestic products is assumed.

As we know, capital formation and productivity growth is a gradual process. Capturing this dynamic process is a key component of the DCGE model. Given that the current model is highly disaggregated into sectors, and, together with multiple households, it is unrealistic to expect a fully developed intertemporal general equilibrium model for this study.[4] Thus, recursive dynamics are applied in the model. With such a model setup, the dynamics occur only between two periods, and neither consumption smoothing along the growth path, nor intertemporal investment and saving decisions are taken into account. Instead, private investment (hence capital accumulation) is determined by a Solow type of saving decision, in which savings are proportional to income and not endogenously solved from a Ramsey type of intertemporal utility function.[5] It is well known that China has run a huge surplus in trade

[3] A mathematical presentation of the DCGE model for China is available from the authors upon request.

[4] An intertemporal general equilibrium model in literature is often used with a relatively aggregated economic structure. See Diao, Rattsø, and Stokke (2005) for a growth analysis for Thailand.

[5] See Diao, Yeldan, and Roe (1998) for discussion of the Ramsey-type intertemporal utility function and its role in determining consumers' consumption and saving behaviors.

and in its current account. While a recursive dynamic CGE model is unable to capture changes in the balance of trade and the current account endogenously, such changes are handled through the choice of macro closure for the current account. In the current model, to define an equilibrium for the current account, growth in the amount of current account surplus is exogenously determined. Other dynamic factors include population (and hence labor supply) growth, land expansion, and productivity change,[6] which are all exogenous variables in such a model setup.

The government is generally included in a CGE model as an institutional account. In the current model, the Chinese government collects taxes (including tax revenue from domestic households and producers, export taxes, and import tariffs), transfers part of this income to households, and uses the rest either as investments or recurrent spending. In the simulation of the model, the stimulus package is introduced as increased government investment, which will be discussed later.

The database used in a CGE modeling analysis is called a social accounting matrix (SAM). While a 2005 SAM for China is available, it needs to be updated, and the highly aggregated agricultural sectors need to be further disaggregated. These steps have been done for this study: here the Chinese economy is represented by a SAM with 61 production sectors in 2007. A list of sectors for the updated SAM is presented in Table A2 of the Appendix, while the economic structure is presented in Table A3 of the Appendix. In the 2007 SAM, the aggregated households in the original 2005 SAM are split into two groups to represent the rural and urban households. Other 2007 data that are used for updating the SAM include the sector growth rate, detailed crop and livestock production and growth, disaggregated exports and imports by commodity group, disaggregated government expenditure, current account, and rural and urban household consumption expenditure surveys. All the data used in the SAM updating are drawn from published information by official government sources.

[6] It is possible to link productivity growth with public investment if the estimated growth elasticity for China is available.

6. ASSESSING THE IMPACT OF GLOBAL RECESSION ON CHINA'S ECONOMY

We first calibrate the base year (2007) of the DCGE model according to the updated SAM. We then develop a base-run scenario based on the information available for sectoral-level growth and exports and imports in 2008 and early 2009. In the base run, the Chinese economy moves along its recent growth trend (before the global recession) through 2008. We did not consider the impact of external shocks on China's economy in 2008 as such effects did not occur until the last quarter of 2008, and the DCGE model is an annual base model. We then impose a series of exogenous shocks that reflect the main channels through which China's economy has been negatively affected by the world recession in the year 2009 of the model. After 2009, there is no additional exogenous shock in the model, and the model solves for a series of endogenous variables for each year between 2008 and 2015.

Three types of shocks are exogenously imposed in the base-run model for 2009. The most important shock is imposed on the trade sector and the sudden decline in FDI inflows. In any single country CGE model, world prices are exogenous, while imports and exports are endogenous variables. Thus, by lowering the world prices faced by China's exports and imports, we try to capture the declines in external demand for China's exports and the declines in the import demand of Chinese export sectors as a result of the decrease in exports. Ideally, the price shocks should roughly approximate actual price changes. However, given that most subsectors are aggregated, it is unlikely to identify their price changes in the world market, particularly for those subsectors that the Chinese economy heavily depends on either through exports or imports. Such subsectors include textile and clothing, electric manufacturing, electronic manufacturing, telecom manufacturing, and transport equipment, which all compose by many individual products and product varieties. Thus, it is impossible to identify a single commodity price for them, and we have to impose an arbitrary price shock in the model. Specifically, 10 percent of a one-time decline in the world prices faced by Chinese firms as exporters and 5.5 percent of that faced by such firms as importers are uniformly imposed in the base run for 2009.[7] We also assume that world prices will stay at their 2009 level until 2015. With such world price declines, we try to simulate a decrease in exports and imports similar to what occurred in the first quarter of 2009, with an assumption that such declines in China's trade will last through the whole year of 2009 if there is no government intervention (such as the stimulus package that will be modeled later).

The second shock is imposed on foreign inflows, which is an exogenous variable in a recursive dynamic CGE model. Foreign inflows capture the imbalance between exports and imports. A negative (positive) foreign inflow is consistent with a trade surplus (deficit) and indicates foreign outflows, which is the case in China. While the flow of FDI is captured by the capital account, it often relates to the increases in imports and hence enhances the foreign inflows measured as trade deficit. Thus, we cannot model changes in FDI inflows independent of changes in total trade balance. Instead, we model the net foreign outflows by altering its annual growth rate from 12.8 percent in 2008 to 6.4 percent in 2009. The annual growth rate of foreign outflows further slows down to 5.1 percent after 2009 until 2015. With such exogenous adjustment in foreign account closure, together with declined world prices for exports and imports, growth rate in both exports and imports becomes negative in 2009, and turns to be positive but with much more modest growth than that in the recent history after 2009. Moreover, the growth rate for exports will be slightly slower than the growth rate for imports due to the exogenous slow-down in increases in trade surplus in the model.

The third type of shock is to the productivity of factors employed in the production process. Because of a sudden decline in foreign countries' demand for China's export goods, many sectors, particularly those that are export oriented, have to cut their production, which implies underutilization of their existing capacity, particularly machinery and other types of capital, as well as that portion of their current employment force that they cannot lay off right away. To model such a sudden decline in the

[7] Given that it is extremely difficult to obtain the world prices for most export and import nonagricultural products that compose wide variety of products within each subsector defined in the model, the choice of price shock is based on the desired outcome of the shock on the exports and imports.

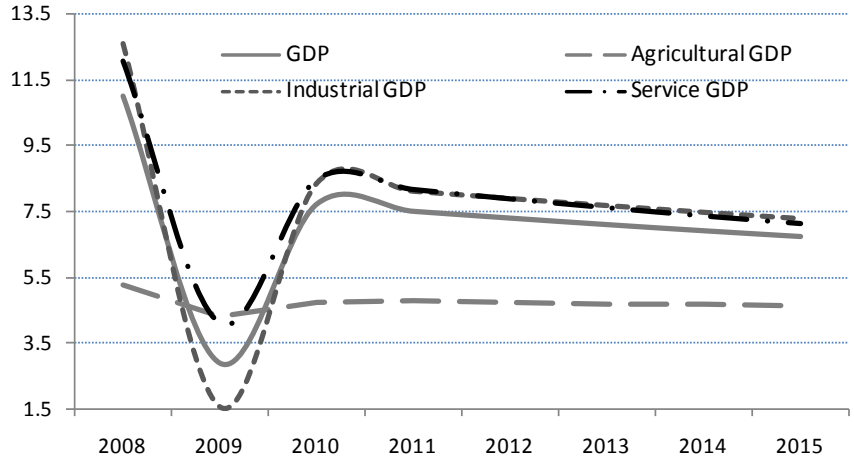
productivity of some sectors, we exogenously lower the level of 2009 total factor productivity (TFP) for those export-oriented manufacturing and service sectors. After 2009, growth is restored in these sectors' TFP, but it starts from the lowered level in 2009. While there is no exogenous shock imposed on those sectors that are primarily in the domestic market, such as agricultural production and private services other than hotels and restaurants and real estate, those sectors will be affected by the world recession through the general equilibrium linkages of the model. We will discuss such linkage effects later.

To partially capture the employment effect of the world recession, we consider two types of labor in the model. We define low-skilled labor as having flexible supply, and skilled labor as having fixed supply. The initial growth rate of skilled labor is assumed to be 2.0 percent annually and not affected in 2009. About 88 percent of the labor force is assumed to be low skilled with a much lower wage rate. We model a flexible supply of such a labor force with an average wage rate initially about 50 percent of the average wage rate for skilled labor. Change in the average wage rate for the low-skilled labor is endogenously linked to change in the average wage rate for the skilled labor, while the skilled labor wage rate is an endogenous variable in the model. We assume a low elasticity in the wage link between the two types of labor to capture the much slower growth rate in the wage rate for low-skilled labor, which is consistent with the situation in the last 10 years before the recession. Specifically, if the average wage rate of skilled labor grew by 10 percent a year, the growth rate for the low-skilled labor wage would be 1.4 percent. When the Chinese economy is hit by a decline in export demand that causes factor productivity to fall, the number of low-skilled labor employed in the economy declines. The results of such a model will be discussed later.

Large Negative Growth Effect

The possible impacts of the recent global recession on the Chinese economy are first analyzed without taking into account the government stimulus package. We first report the effect on the growth rate of GDP and GDP by sector in Figure 13.

Figure 13. Annual growth rate of total and sectoral GDP in the base run (%), 2008–15



Source: China's DCGE model results.

By ignoring the decline in the Chinese economy in the last quarter of 2008, the GDP growth rate of 2008 as an endogenous result of the DCGE model is higher than the growth rate reported by the China's National Bureau of Statistics (see Table A1 in the Appendix), which is 9 percent for 2008. The model simulation results in a growth rate of 11 percent in 2008. While the model result for the GDP growth rate in 2008 is higher than the actual growth rate for that year, it is comparable with the growth between 2003 and 2007, which ranges from 10.0 percent in 2003 to 11.9 percent in 2007. The high

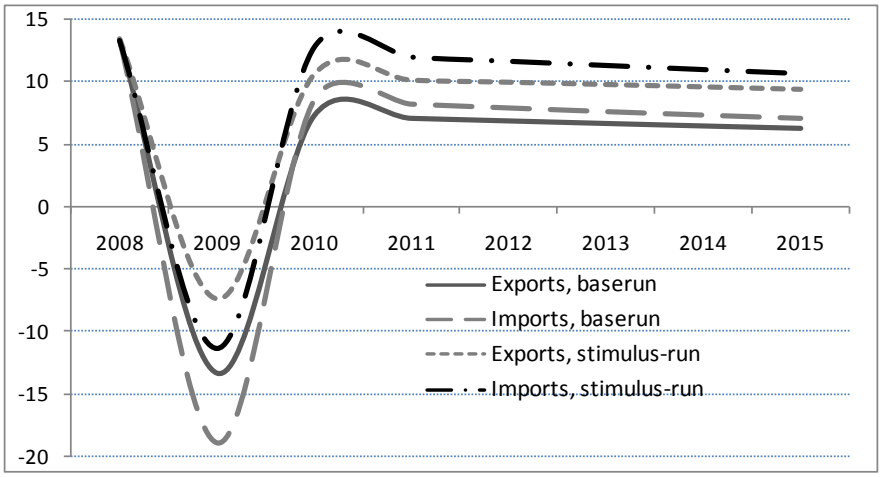
growth in the overall economy in the model is led by growth in the industrial sector, including export-oriented manufacturing sectors and the construction sector. While the official reported industrial and manufacturing GDP growth rates are 9.3 and 9.5 percent, respectively, in 2008, the model results are higher—12.6 and 13.4 percent, respectively— but these high growth rates in the model result are comparable to the growth performance until 2008. On the other hand, the growth rate of 5.4 percent for the agricultural sector in the model is in line with the official number of 5.5 percent in 2008.

Trade Leads the Decline in Economic Growth

With the imposition of shocks in the DCGE model to represent the direct impact of the global recession in year 2009 of the base run, the overall economic growth contracts significantly. The growth rate of total GDP falls to 2.9 percent in 2009 in the model, led by the decline in industrial growth, which falls to 1.6 percent in 2009 (Figure 13).

Two factors contribute to the declining industrial growth. The primary factor is the decline in the trade sector, which, by design, is hit harder than the overall economy during the recession (Figure 13). While the financial crisis in the developed countries induces a world recession, China's capital (and hence financial) markets are relatively less open to the world financial movement: therefore, the dominant link between the Chinese economy and the world is through the trade channel. The model tries to capture this channel by the exogenous shocks discussed previously. Thus, as shown in Figure 14, total exports and imports in the model fall 14 to 19 percent in 2009. Moreover, the decline in total exports is led by a few highly export-intensive manufacturing sectors, such as textiles and related products and manufacture of communication equipment, computers, and other electronic equipment. Figure 15 displays the simulation results for the growth rate in exports in these selected manufacturing sectors. The worst case is electronic manufacturing exports, which decline by 50 percent in 2009 in the model.

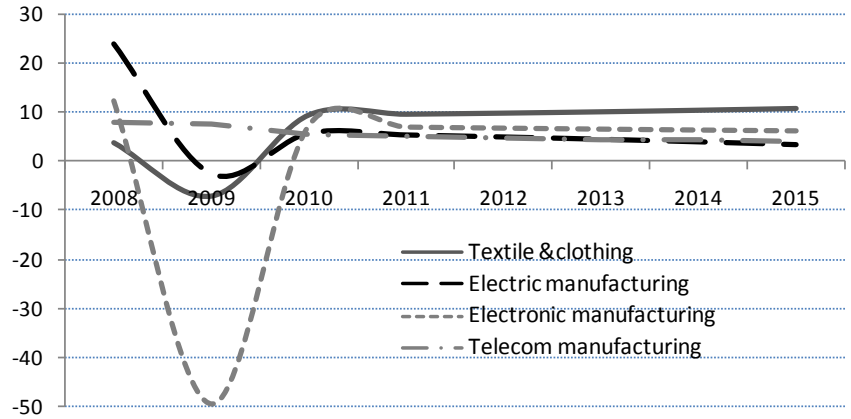
Figure 14. Growth rate of total exports and imports (%), 2008–15



Source: China's DCGE model results.

Many export-oriented manufacturing sectors in China are also import-intensive. When their production declines, their demand for imported intermediates falls. The demand side effect is the general equilibrium result of the model. Together with declined investment demand, which is also a general equilibrium result, total imports fall (in percent) more than the decline in total exports in the model for 2009 (Figure 13, base run), which is consistent with actual data reported by the government.

Figure 15. Growth rate of exports for selected manufacturing goods in the base run, 2008–15



Source: China's DCGE model results.

The slowdown in growth in the industrial sector (as shown in Figure 13) is also due to the decline in construction, which is a non-traded sector. In the DCGE model, investment is financed by savings, which includes savings from firms, households, and the government. When firms lower their investment (savings) due to declining returns to their previous investment (as returns to capital), demand for investment goods falls and hence growth in the construction subsector also falls. In the model, output of investment declines by 17 percent in 2009, which causes the sector's value-added to fall by 7.9 percent in 2009.

The Agricultural Sector Is Relatively Crisis-Resistant

The agricultural sector, however, is somewhat resistant to shocks coming from the external world, as China's agricultural exports and imports are much less important for this sector's growth performance than are exports and imports for the performance of the manufacturing sector. By design of the simulation, there is no exogenous shock on agricultural productivity growth in all scenarios. However, through the general equilibrium linkages, we still observe that growth in the agricultural GDP in the model falls modestly to 4.4 percent in 2009 from 5.4 percent in 2008 (Figure 13).

Less dependency on trade in China's agricultural sector indicates that in order to understand the main channels that affect agricultural growth we need to focus on those factors that are not directly shocked in the model. We first focus on the supply side. When rural migrants lose their jobs in the urban sector, they have to return to their rural home base, which increases the labor supply in the agricultural sector and hence can be expected to have a positive impact on agricultural production. However, China's agriculture is primarily constrained by land, not labor. Returned rural migrants will not be able to produce more agricultural goods in the short run because they face a land constraint. Thus, the model result shows that, while low-skilled labor employment in the industrial sector falls by 3.5 percent nationwide, employment in the agricultural sector does not increase in 2009.

Obviously, supply-side factors do not explain the reason the decline in agricultural production in the face of the global recession, so now we turn to the demand side. When the Chinese economy is hit by the global recession, we expect growth in household income to slow at the national level. Indeed, the model reproduces slow growth in both rural and urban household incomes, which is consistent with data recently published by the National Bureau of Statistics of China. However, agricultural demand is less income sensitive than the demand for nonagricultural goods in today's Chinese economy. While food spending still accounts for more than 40 percent of rural households' total consumption expenditure in 2007, the food budget share is much smaller for urban households, about 30 percent in 2007. Moreover, with rapid income growth between 2004 and 2007, the food budget share declines in the last three years

for both rural and urban households. Along this trend, the model predicts that the food consumption share will continue to fall in the base run. With a declining share of food consumption in total consumer spending, agricultural growth can be constrained by demand in a normal year without a global crisis, in addition to the land constraint that the country has faced for many years. In a crisis year, for a similar reason, agriculture is less affected on the demand side too.

Impact of the Global Recession Would Last for Many Years

It is important to notice that in the growth figures presented above growth will slow down not only in the year 2009, when the economy was suddenly hit by the global recession, but also in the years after. While the shock on the productivity side is only imposed in 2009 in the model, world prices are not expected to return immediately to their 2008 level due to the global recession. Thus, the negative effect of the recession on China's economic growth will continue after 2009. For example, as shown in Figure 13, growth in total and sectoral GDP rises in 2010 from a much lower level of GDP in 2009. However, the recovered growth in 2010 is much lower than that in 2008 before the crisis (7.7 percent in 2010 in the model). A similar pattern of growth is also observed for the industrial and service GDPs in Figure 13 and the trade growth in Figures 14 and 15. Only for the agricultural sector is the annual growth of 4.9 percent in 2010 and after comparable to the 2008 rate of 5.5 percent in reality. Moreover, the annual growth rate of total GDP in the years after 2010 is even lower than that in 2010, and it slows down to 6.7 percent by 2015 (Figure 13).

In summary, the base run of the DCGE model results indicate that while the financial crisis may be a short-lived phenomenon, the impact of it on the Chinese economy will last much longer due to the recession. The stimulus package introduced by the Chinese government will not only help China cope with the short-run shock of the crisis, it will also allow the Chinese economy to continue its rapid growth momentum in the years after the shock.

7. HOW WILL THE STIMULUS PACKAGE WORK THROUGH THE ECONOMY?

Before we start the discussion of the model results, we need to know what a CGE model can do in assessing the impact of such a stimulus package. Similar to many other applied general equilibrium models, the DCGE model developed for China is a model for the real side of the economy. Therefore, the model does not explicitly capture any financial movement of the economy or the role of monetary supply and demand. Because of this generic limitation to the model, we are unable to fully assess the entire process of economic response to a stimulus package, which in general works through increased financial supply to create additional demand for existing production capacity. Such a financial supply can be a government's direct investment through fiscal channels or a private investment through increased banking loans with more relaxed borrowing conditions. When an increased financial supply is inserted into an economy, the real and financial sides of the economy both respond. This can further affect the real side of the economy through future inflation, if too much money is inserted into the economy. However, when we analyze the real side of the economic impact of the stimulus package in this study, we ignore both the financial factors and the second-run effects of financial factors on the real economy through possible future inflation risks.

The direct objective of a stimulus package is to stimulate economic growth through additional demand on the current production and trade capacities (including factors such as labor, land, and capital), which have become underutilized as the economy contracts in the recession. In the case of China, the majority of additional demand comes from growth in investment financed by the government. Given that the lion's share of such investment goes to increasing public goods such as roads and other infrastructure, its growth is highly related to the demand for domestically produced goods and services. We model such investment through increased government spending on these capital goods and services, assuming that such increased spending will not be financed by increased government saving or tax revenue (which will force the private sector to reduce their savings). In the model language of the macro-closure, this assumption implies that the government uses additional income sources to finance its investment and such additional income sources are created by the stimulus package.[8]

When government increases its demand for investment goods, it first directly stimulates production of these capital good sectors. In its general equilibrium setting, when capital good production sectors increase supply of their products, they need to use more inputs, such as labor, capital, and intermediates. Increased demand for labor creates jobs for unemployed low-skilled labor and raises the wage rate for the skilled labor, the supply of which is assumed to be fixed in the model. Increased demand for capital raises the return to capital, which makes future private-sector investment more profitable. Increased demand for intermediate goods will directly create markets for these goods, and hence, the supply of such goods can further increase to meet such demand. We model this process by assuming that the underutilized production capacity due to the crisis can be partially put into production, which implies the recovery of productivity of these sectors to close to the pre-crisis level.

Finally, when the private sectors, including firms and households, increase their income due to investment-induced production growth, they also increase their savings, which further stimulates investment. We model the increased private savings (and hence investment) by assuming that firms' and households' savings are proportional to their income.

We conduct all these simulation exercises in a scenario called the "stimulus run." While we describe these processes in response to a stimulus package sequentially and individually, they actually work together in the stimulus run. The simultaneous response of the model's supply side causes a short-term impact (in year 2009 of the model, for example), while the investment-side response, together with

[8] We did not include the targeted direct transfer from the government to the low-income households given that the households in the model are highly aggregated and total welfare-related transfer to the households is less than 4 percent of the stimulus package. Also, we did not model any policy reforms included in the stimulus package such as tax reforms, subsidy policies and other industrial structural adjustment policies given that little implementing information about such reforms is available to the public.

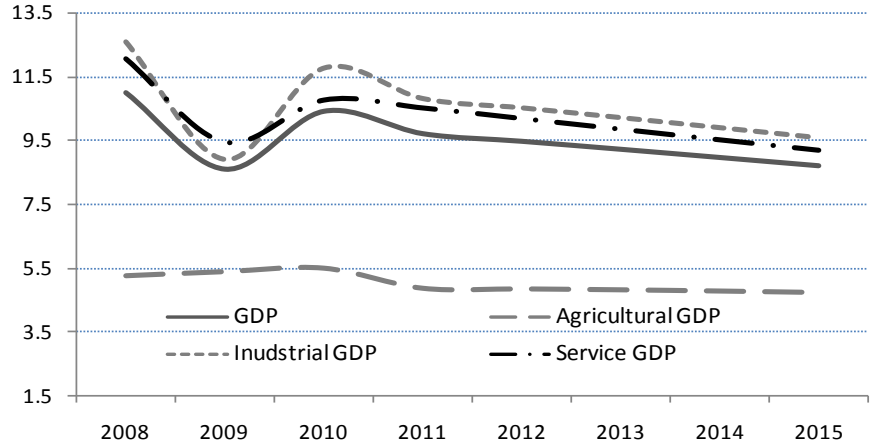
the supply response due to increased capital formation, will be a medium-term impact in the DCGE model.

Public good investment will also have a positive externality effect on the private sectors' productivity. More high quality roads significantly reduce the transportation and transaction costs for firms, while other infrastructural investments often improve the external conditions for the private sectors doing business. Moreover, taking a crisis as an opportunity, investments in technological change and innovation are directly included in the stimulus package and a series of new industrial strategies will be implemented in 2009 and after. With such investments, it can be expected that productivity will grow more rapidly and China's competitiveness in the world will be further improved. We call a productivity-led growth impact of the stimulus package a long-run impact. Given that such an impact takes time to be realized, and there is little evidence to provide the model for conducting a long-run simulation, we will not consider it in this study.

A Significant Positive Short-Run Growth Effect

Now we turn to the model results of the stimulus run, where we discuss a group of economic indicators similar to those for the model's base-run results to quantitatively measure the impact of the stimulus package on growth, trade, and income. We start with Figure 16 (similar to Figure 13) to show the growth impact. Then to make it easy to compare Figure 16 with Figure 13, we keep the same scale on the *y* axis as that in Figure 13 to show the different results under the two scenarios. In Figure 16, while the growth rate of total GDP in 2009 is still lower than that in 2008, the year previous to the global crisis, the growth rate of 8.6 percent is much higher than that in the base run (2.9 percent) in the model for 2009. A similar growth rate (8.9 percent) is obtained for the industrial GDP (1.6 percent in the base run). The growth in GDP of the service sector rises to 9.4 percent, from 4.1 percent in 2009 of the base run. While the agricultural sector has some resilience in the face of the global crisis, it benefits only modestly from the stimulus package, growth in agricultural GDP increases to 5.5 percent from 4.4 percent in the model's base run.

Figure 16. Annual growth rate of total and sectoral GDP in the stimulus run (%), 2008–15



Source: China's DCGE model results.

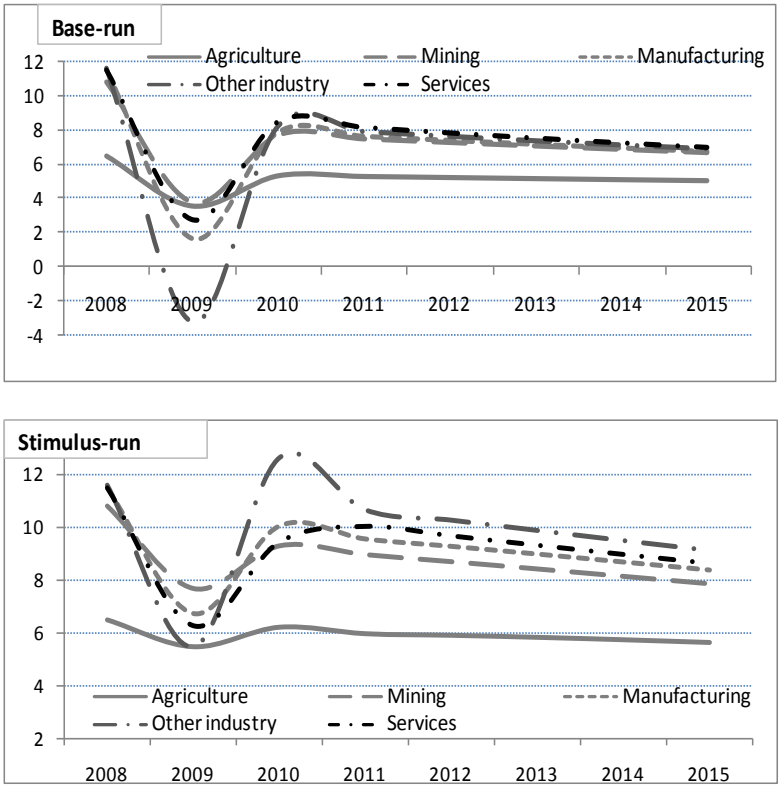
Growth in the industrial sector can be partially explained by the recovery of underutilized production capacities, as we have exogenously brought the sector levels of TFP back to the same levels as in 2008. However, growth in the agricultural sectors and part of the service sectors is all driven by demand, as we did not change the sectoral TFPs of 2009 in either the base run or the stimulus run.

Domestic Demand-Led Growth

Turning to the trade sector, we start with the growth in total exports and imports presented in Figure 13 above. In contrast to the GDP growth for the overall economy and individual sectors, change in the export or import growth rates is rather modest in the stimulus run in comparison with the base run. That is to say, total exports and imports continue to fall even with the stimulus package, though the magnitude of the declines becomes smaller than those in the base run. Compared with import growth, the recovery in export growth seems to be more rapid. Instead of a 13.2 percent year-to-year drop in exports in 2009 in the base-run model, exports decline by 7.4 percent in the same year in the stimulus run. On the other hand, imports still decline by 11.3 percent in the stimulus run (compared with a decline of 18.9 percent in the base run).

Therefore, domestic demand has become the main engine for stimulating growth through the stimulus package. This is obvious because most measures applied in the stimulus package target domestic investment and demand for domestic factors and inputs. To further understand the role of domestic demand in stimulating growth during a global crisis, we display the growth in production that is produced for domestic markets in Figure 17. Aggregating production into five broad groups, the first panel of Figure 16 shows a similar pattern of growth in domestically produced and consumed goods as that for the sector's GDP (in Figure 13) under the base run. For example, led by the decline in construction, domestically consumed industrial production other than mining and manufacturing decreases by 3.2 percent in the base run for 2009, declining from an 11.6 percent growth level in 2008, while the growth rate of manufactured products produced and consumed domestically falls to 1.7 percent in 2009 from 11.5 percent in 2008. All growth rates are measured in real terms, that is, in base-year prices at the commodity level. The second part of Figure 17 shows the growth rate of the same groups of products during the same time period under the stimulus run. While growth rates rise in all the domestic production sectors, the rise is sharper for industrial goods. For example, the growth rate of other industrial products produced for the domestic market rises to 5.5 percent in 2009 and that for the manufacturing sector rises to 6.8 percent.

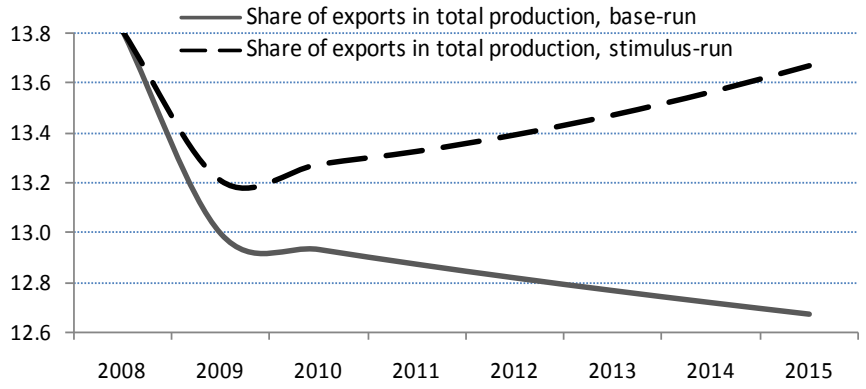
Figure 17. Growth in domestic demand and produced products, base and stimulus runs, 2008–15



Source: China's DCGE model results.

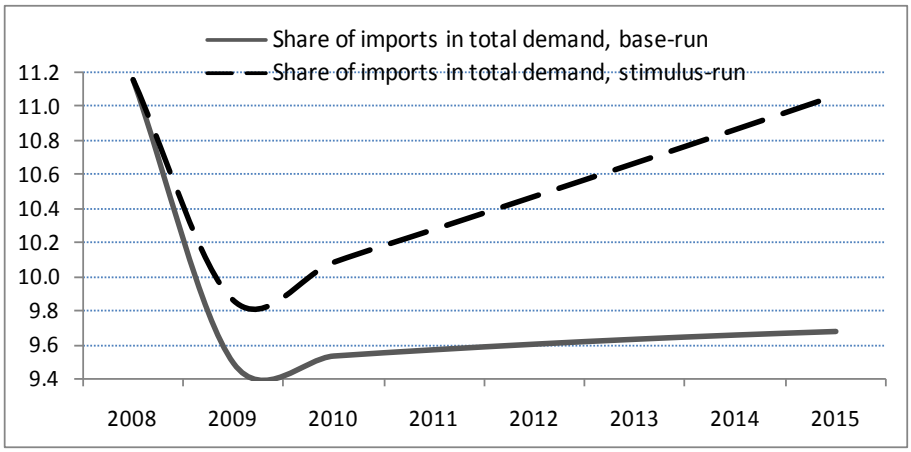
The other way to evaluate the importance of the domestic market in stimulating growth during and after the global recession is to look at the share of trade in either domestic production or consumption. We report such shares in Figures 18 and 19. While exports account for 40 percent of China's GDP, when measured as a share of the gross value of production, it is about 13.8 percent. Similarly, for imports, which are equivalent to 30 percent of GDP, its share in total domestic absorption, including intermediate, consumer, government, and investment demand, is about 11.2 percent in a normal year. When the global crisis hits the growth in Chinese economy, it lowers the dependency of the economy on exports and imports. In the crisis year of 2009 in the base run, the export–production ratio falls to 13.0 percent from 13.8 percent in 2008, and the import–consumption ratio falls to 9.5 percent from 11.2 percent in 2008. With the stimulus package effect, such trade dependency shares rise only modestly, although the growth rate in GDP increases much more (as shown in Figure 15). Even taking into account the medium-run effect, the shares of exports and imports in the Chinese economy will not come back to their peak in recent years. Obviously, less dependency on external markets and increased importance of domestic markets in growth will help China maintain its growth momentum and thus be less vulnerable to external shocks.

Figure 18. Share of exports in total production, base and stimulus runs (%) 2008–15



Source: China's DCGE model results.

Figure 19. Share of imports in total consumption, base and stimulus runs (%), 2008-15



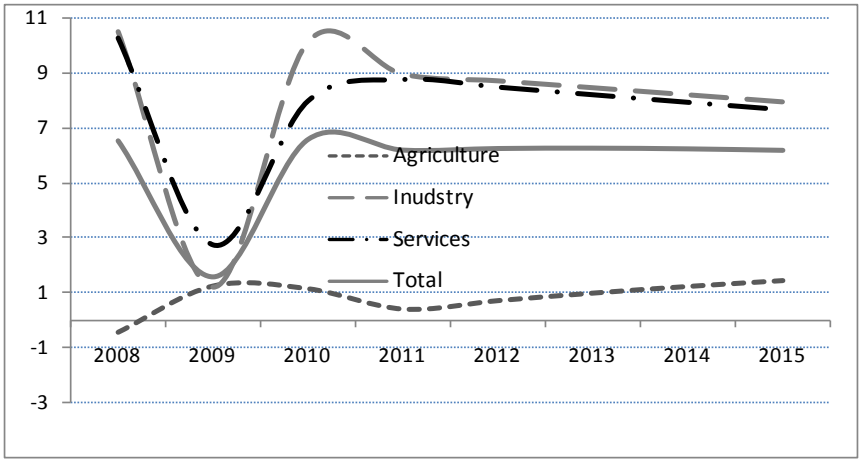
Source: China's DCGE model results.

The Stimulus Package Will Create Jobs

One important reason for designing a stimulus package is to lower the unemployment pressure, which is an outcome of the decrease in export demand for Chinese products. Therefore it is necessary to check whether there are more employment opportunities with the stimulus package than without. As mentioned in section 3, we assume that the labor supply for low-skilled labor is flexible, while the supply of skilled labor is fixed and grows exogenously in the model. A flexible labor supply assumption implies that the number of employed, low- skilled labor is determined by the demand for it. If the Chinese economy is hit by the global recession without a government stimulus package, demand for such labor stops growing, declining by 1.2 percent in 2009, compared with 2008. On the other hand without the crisis in 2008, the model shows an annual growth rate of 7 percent in total demand for low-skilled labor and more than 10 percent growth in such labor demand in the industrial and service sectors.

The model result shows that stimulated economic growth under the stimulus run is accompanied by increased demand for labor. While total labor demand only grows modestly at 1.6 percent in 2009, the growth rate recovers to its precrisis level of 6.6 percent in 2010. As expected, most jobs are created in the industrial and service sectors, particularly the service sector in2009. However, in the year following the crisis year of 2009, the growth rate of labor demand in the industrial sector jumps to more than 10 percent, from its lowest level in 2009 (Figure 20).

Figure 20. Growth in low-skilled labor demand under the stimulus run (%), 2008–15

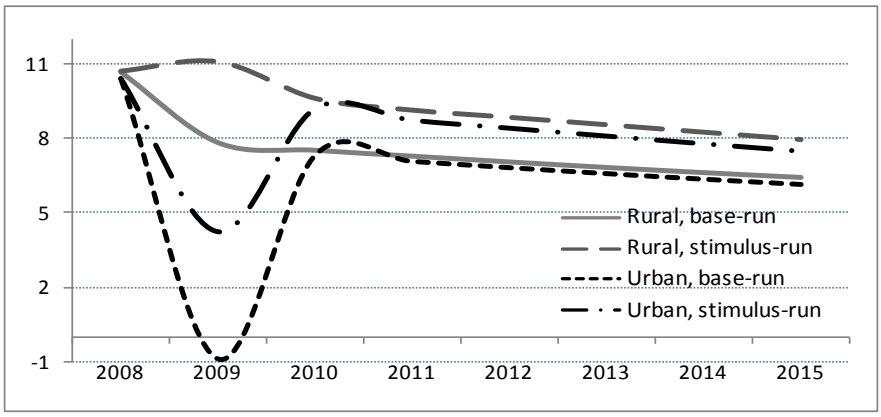


Source: China's DCGE model results.

Stimulus Package Benefits both Rural and Urban Households

The historical data show that recent economic growth has benefited urban households more than rural households, and the increasing rural-urban income gap has been a growing concern for the government. In this study we are unable to model the interventions identified in the stimulus package to specifically target rural development and agricultural growth due to lack of detailed information for understanding the channel of these interventions to stimulate rural income growth. What we capture in the analysis is the general impact of stimulated growth that is domestic demand led and that will create more job opportunities for low-skilled labor, of which many are rural migrants. Even focusing only on such impacts, the model result shows that both rural and urban households benefit from the stimulated economic growth. As shown in Figure 21, the factor income growth rate is higher for rural households (11.1 percent) than for the urban households (4.2 percent) in 2009 in the stimulus-run model, and income growth converges between the two groups of households after that. Taking into account the medium-term effect, the income growth rate for both household groups is still higher than that under the base run without a stimulus package, though such growth is slower than the high pre-crisis level.

Figure 21. Growth in factor income for rural and urban households (%), 2008–15



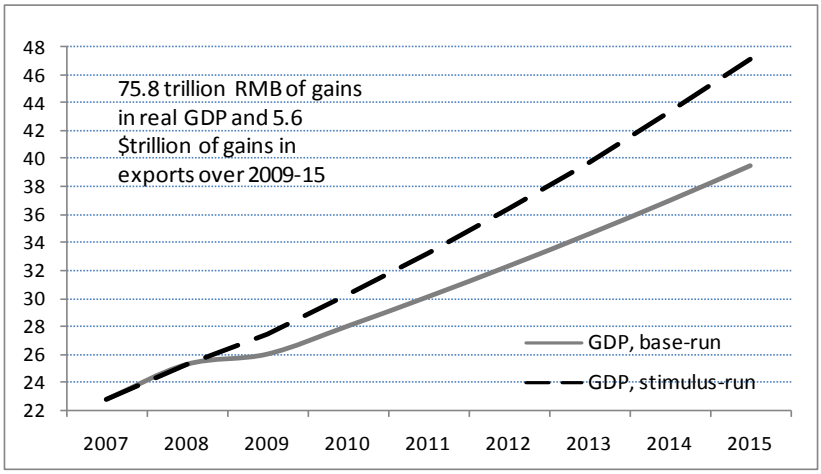
Source: China's DCGE model results.

We must point out that the model is highly aggregated in defining households, and within-household heterogeneity has been ignored because of this aggregation. Obviously, some households in some regions are affected more by the crisis than the national average, both in the rural and urban areas. Although an assessment of income effects at the micro level among the different households is very important, it is beyond the scope of this paper.

Measuring the Overall Gains of the Stimulus Package in Short to Medium Runs

Finally, what are the overall gains of the stimulus package to economic growth? We assess such gains using the difference between the levels of total GDP (in 2008 prices) under the two scenarios during the period 2009–15 (Figure 22). As we mentioned before, in this analysis we did not consider the productivity enhancement role of public investment as a part of the stimulus package, as such impacts may not be seen during the implementation years of the package (which only lasts for two years in the government document and only one year in the model simulation). Measuring the long-term returns to public good investment requires much more evidence, which is impossible to obtain in the early stage of the implementation. That is, we are not in a position to evaluate the returns to the stimulus package and only consider what this package can possibly bring to the Chinese economy directly in the short to medium runs.

Figure 22. Overall gains of the stimulus package in real GDP (RMB trillion), 2007–15



Source: China's DCGE model results.

To make such an assessment, we simply compare the level of GDP in a hypothetical scenario in which the economy has to deal with the shock from the global recession without government intervention in the base run with the scenario including the stimulus package. As shown in Figure 22, the gap in real GDP in the two different scenarios widens as time moves on. This is not only due to the short-run effects in 2009, in which the stimulus package helps the economy overcome the demand-side constraint from the global market and keeps growing at 8.6 percent (instead of 2.9 percent as in the 2009 base run). This is also because of continuous growth after the crisis year of 2009. As shown in Figure 15, with the stimulus package, the GDP growth rate in the years after 2009 is higher than the growth rate in 2009—in a range of 9 to 10.4 percent per year. But in the base run (without the stimulus package) economic growth only recovers to about 7 percent per year during the same period (Figure 13). With such a difference in the annual growth rate, the accumulative difference in GDP, measured in 2008 prices, is about RMB 76 trillion over the next seven years (2009–15). This number is about three times the 2007 GDP. That is to say, the immediate- and medium-term gains of the stimulus package (without taking into account the long-term impact of productivity enhancement) are roughly about three years' GDP. By year 2015, the level of total GDP (in real terms) will be RMB 7.7 trillion higher under the stimulus run than that in the base run, which implies that in just one year the level of GDP will be about 20 percent higher than it would have been without this package.

We also measure the gains in China's total exports using a similar method. The total gains are about US$5.6 trillion using the current exchange rate of 7:1. With this exchange rate, it is equivalent to half of the gains in GDP in the same period. Putting it another way, the model results indicate that about half of the gains created by the stimulus package depend on external markets, while the other half comes from domestic demand. Such balanced growth between export dependency and domestic market orientation will be the key for China to have sustained growth in the long run.

8. CONCLUSION

As one of the largest economies with high import and export dependency ratios, China's economy has been hit by the recent global recession. China is also one of a few countries in the world that responded quickly to the crisis by implementing one of the world's largest stimulus packages in late 2008 and early 2009. In this study, we developed a DCGE model for China and used this model to quantitatively assess the impact of the global recession and China's stimulus package. While the actual economic growth rate fell to 6.1 percent in the first quarter of 2009 and recovered to 7.9 percent in the second quarter of 2009, the model simulation shows that the negative growth effect, without the stimulus package, would be much more serious. The model also shows that the most affected sector is industry, particularly export-oriented manufacturing and construction, while the agricultural sector seems to be more resilient. While the agricultural growth rate declines modestly in the model, rural income is negatively affected due to increased unemployment in the urban sector, which provides income to the rural households through rural migrants working in the urban sector.

The analysis of the impact of China's stimulus package focuses on the short and medium runs. While the stimulus package is expected to have strong long-run effects, given that industrial structural change and technological innovation are directly targeted in the package, the model cannot assess such an impact because not enough information is currently available. The analysis shows that domestic demand will play the most important role in growth under the stimulus package. While annual growth recovers to more than 8 percent in 2009 and after, with increased domestic investment and consumer demand, growth in trade is unlikely to recover quickly. Although growth engines differ between stimulus growth and past growth, the stimulus package does create jobs and hence increases income for both urban and rural households.

The model is also used to measure the overall gains of the stimulus package by comparing GDP levels in the two different scenarios discussed above. Without considering the productivity enhancing role of public investment as part of the stimulus package (which is important for long-term growth but unlikely to happen in the short run), the accumulative difference in the two scenarios' GDP is about RMB 76 trillion over the next seven years. This number is about three times that of GDP in 2007.

In conclusion, traditional Chinese philosophy views a crisis as also an opportunity. Taking the opportunity of the current global recession, China is in the process of adjusting its growth strategy to focus more on domestic demand, on rural development, and on advancing industrial structure. By fully implementing this new growth strategy, China may continue to surprise the world with a new growth miracle in the next 10 to 20 years.

APPENDIX: SUPPLEMENTARY TABLES

Table A.1. Growth rate of selected economic indicators

	GDP	Agricultural GDP	Industrial GDP	Service GDP	Exports	Imports	FDI
2004-07	11.3	5.1	12.6	11.6	29.2	23.6	5.6
2008	9.0	5.5	9.3	9.5	17.2	18.5	23.6
Q1-2008	10.6	2.8	11.5	10.9	21.4	28.6	61.3
Q2-2008	10.2	4.0	11.2	10.5	22.5	32.4	37.9
Q3-2008	9.0	5.6	9.0	10.1	23.2	26.0	23.8
Q4-2008	6.8	7.2	6.1	7.4	4.7	-7.9	-21.1
Q1-2009	6.1	3.5	5.3	7.4	-19.7	-30.9	-20.6
Q2-2009	7.9	3.8	6.6	8.3	-23.5	-20.5	-15.7
Q3-2009	8.9	4.0			-22.6	-18.8	-14.4

Sources: GDP data from China Statistical Yearbook (NBS 2009a) and website of National Bureau of Statistics of China Trade(China Custom Statistics 2009); foreign direct investment (FDI) data from website of the Ministry of Commerce of China (Ministry of Commerce 2009).

Table A.2. Sector list in China's 2007 SAM

Agriculture		31	Chemistry
1	Rice	32	Non-metallic mineral products
2	Wheat	33	Pressing of metals
3	Maize	34	Metal products
4	Other grain	35	Machinery
5	Bean	36	Transport equipment
6	Oil crop	37	Electrical machinery
7	Cotton	38	Communication equipment
8	Sugar	39	Measuring instruments and machinery
9	Vegetable	40	Other manufactures
10	Fruit	41	Recycling waste
11	Other crops	42	Electric and heat power
12	Pork	43	Gas supply
13	Beef	44	Water supply
14	Mutton	45	Construction
15	Poultry	Services	
16	Other livestock	46	Transport
17	Forestry	47	Post
18	Logging and transport of wood	48	Information and computer services
19	Fishing	49	Trade
20	Agricultural services	50	Hotel and restaurant
Industry		51	Finance
21	Mining	52	Real estate
22	Petroleum and natural gas	53	Leasing
23	Metal mining	54	Research
24	Nonmetal mining	55	Technical services
25	Foods and Tobacco	56	Environment and public facilities
26	Textile	57	Other private services
27	Leather and products	58	Education
28	Wood manufacture	59	Health
29	Paper and printing	60	Entertainment
30	Petroleum	61	Other public services

Source: China 2007 SAM.

A.3a. Economic structure in China's 2007 SAM

	Share of value-added (%)	Share of employment (%)	Share of exports (%)	Export-output ratio (%)	Import-absorption ratio (%)	Import-final demand ratio (%)
Rice	1.0	3.3	0.0	0.8	0.0	0.4
Wheat	0.5	1.5	0.0	2.4	0.0	0.1
Maize	0.6	2.3	0.0	2.3	0.0	0.7
Other grains	0.4	1.2				
Bean	0.2	0.9	0.0	4.2	0.8	48.7
Oil crop	0.3	0.9	0.0	3.0		
Cotton	0.4	1.6	0.0	0.2	0.3	14.6
Sugar	0.1	0.4				
Vegetable	1.4	5.5	0.2	5.4		
Fruit	0.5	2.1	0.0	2.0		
Other crops	0.6	2.0	0.1	3.9		
Pork	1.5	4.1	0.0	0.4		
Beef	0.2	0.4	0.0	0.4		
Mutton	0.2	0.6				
Poultry	0.4	1.0	0.0	0.3		
Other livestock	0.4	0.9	0.0	0.1		
Forestry	0.4	0.7			0.6	26.3
Logging and transport of wood	0.1	0.1	0.0	7.9		
Fishing	1.1	1.5	0.3	5.4		
Agricultural services	0.3	0.5				
Mining	1.9	1.1	0.3	3.0	0.2	1.3
Petroleum/natural gas	1.8	0.3	0.1	1.2	4.0	29.3
Metal mining	0.6	0.2	0.0	0.5	3.2	34.0
Nonmetal mining	0.4	0.2	0.0	1.3		
Foods and Tobacco	2.8	2.9	0.1	0.4	0.5	1.2
Textile	1.4	1.9	1.1	5.7	0.2	1.0
Leather and products	1.6	2.1	9.2	51.7		
Wood manufacture	0.7	0.8	1.1	14.6		
Paper and printing	1.1	0.9	0.2	1.3	0.7	3.8
Petroleum	1.0	0.5	0.5	2.7	1.6	6.5
Chemistry	4.6	3.2	1.7	3.1	3.0	4.4
Non-metallic mineral products	2.1	1.6	0.4	1.7		
Pressing of metals	3.6	1.9	3.3	7.6	3.5	6.4
Metal products	1.2	0.9	0.5	3.5	0.0	0.0
Machinery	3.6	2.9	10.7	30.7	0.9	2.7
Transport equipment	2.1	1.6	7.2	29.7	2.6	10.6
Electrical machinery	1.7	1.4	20.0	95.2	30.8	96.1
Communication equipment	2.4	2.1	29.9	80.1	33.7	78.0
Measuring instruments and machinery	0.4	0.4	1.4	28.2	2.3	32.6
Other manufactures	0.5	0.4	0.7	14.8		

Source: China 2007 SAM.

A.3b. Economic structure in China's 2007 SAM

	Share of value-added (%)	Share of employment (%)	Share of exports (%)	Export-output ratio (%)	Import-absorption ratio (%)	Import-final demand ratio (%)
Recycling waste	0.7	0.3				
Electric and heat power	3.3	1.0				
Gas supply	0.1	0.0				
Water supply	0.2	0.1				
Construction	7.5	10.8				
Transport	5.4	4.0	2.6	8.3	3.8	9.4
Post	0.2	0.1				
Information and computer services	2.6	1.1	0.4	3.1	0.3	1.8
Trade	4.5	5.2				
Hotel and restaurant	2.1	2.8	3.2	20.9	2.6	14.4
Finance	3.5	2.0	0.1	0.5	1.0	4.7
Real estate	11.4	2.6				
Leasing	1.7	1.3	4.1	26.9	3.3	18.8
Research	0.3	0.2				
Technical services	0.8	0.9				
Environment and public facilities	0.4	0.5				
Other private services	1.3	1.1				
Education	2.7	2.5				
Health	1.7	1.4				
Entertainment	0.6	0.4	0.2	5.7	0.2	4.4
Other public services	2.9	2.9				
Total agriculture	10.5	31.5	0.9	2.0	1.7	3.0
Total non-agriculture	89.5	68.5	99.1	14.3	98.3	11.5

Source: China 2007 SAM.

REFERENCES

Breisinger, C., X. Diao, and J. Thurlow. 2009. Modeling growth options and structural change to reach middle income country status: The case of Ghana. *Economic Modeling* 26: 514–525.

CASS (Chinese Academy of Social Sciences). 2009. Analysis and forecast on China's economy. Autumn report. http://news.sina.com.cn/c/2009-10-10/130118801621.shtml.

Development Research Center of the State Council Statistical Database System, http://data.drcnet.com.cn/web/ChannelPage.aspx?channel=jgtjsjk, Accessed in February 2009.

Chen, S., and M. Ravallion. 2009. The impact of the global financial crisis on the world's poorest. http://tinyurl.com/ccagl8.

Chen Xiwen. 2009. About 20million rural farmer workers lost jobs, related social problems should be faced, download from CaiJing website: http://www.caijing.com.cn/2009-02-02/110051988.html. Accessed in February 2009

China Custom Statistics. 2009. http://www.chinacustomsstat.com/CustomsStat/hgtj/hgtjexpress.aspx. Accessed in March 2009.

China National Textile and Apparel Council. 2009. Du Yuzhou: Chinese textile industry has the confidence to overcome the difficulties. http://www.ctei.gov.cn/zxzx/126715.htm. Accessed 11-25-2008.

Development Research Center of the State Council. 2009. China: Seeking for new breakthrough in coping with crisis. *Manage World* (6): 4–18.

Diao, X., J. Rattsø, and H. E. Stokke. 2005. International spillovers, productivity growth and openness in Thailand: An intertemporal general equilibrium model analysis. *Journal of Development Economics* 76: 429–450.

Diao, X., E. Yeldan, and T. Roe. 1998. A dimple dynamic applied general equilibrium model of a small open economy: Transitional dynamics and trade policy. *Journal of Economic Development* 23(1): 77–101.

Diao, X., P. Hazell, D. Resnick, and J. Thurlow. 2007. *The role of agriculture in development, implications for Sub-Saharan Africa*. IFPRI Research Report 153. Washington, D.C.: International Food Policy Research Institute.

Haggblade, S., J. Hammer, and P. B. R. Hazell. 1991. Modeling agricultural growth multiplier. *American Journal of Agricultural Economics* 73(2): 361–374.

He, D., Z. Zhang, and W. Zhang. 2009. How large will be the effect of China's fiscal stimulus package on output and employment? Working Paper 05/2009. Hong Kong Monetary Authority, Hong Kong.

Huang, J., S. Rozelle, H. Zhi, and Z. Huang. 2009. Impact of financial crisis on rural labor employment and income in China. Paper presented at the Symposium on Impact of Financial Crisis on Agricultural and Rural Development in Asia, organized by the International Food Policy Research Institute, Beijing, China, October 26–27.

IMF (International Monetary Fund). 2009a. Contractionary forces receding but weak recovery ahead. *World Economy Outlook Update*. July 8, 2009, Washington, D.C.

_____. 2009b. http://www.imf.org/external/np/res/commod/index.asp

Liu, L. 2009. Impact of the global financial crisis on China: Empirical evidence and policy implications. *China & World Economy* 17(6): 1–23.

Lofgren, H., R. Harris, and S. Robinson. 2001. A standard computable general equilibrium (CGE) model in GAMS. Trade and Macroeconomics Discussion Paper No. 75. International Food Policy Research Institute, Washington, D.C.

Mareike, M., and J. Kennan. 2009. The implications of the global financial crisis for developing countries' export volumes and values. ODI Working Papers (Online). June, Overseas Development Institute.

Ministry of Finance. 2009. The Arrangement of Central Government Public Investment Bugdethttp://www.mof.gov.cn/zhengwuxinxi/caizhengxinwen/200906/t20090626_172446.html. Accessed in March 2009.

Ministry of Agriculture. 2009. http://www.agri.gov.cn/sjzl/jdsj.htm. Accessed in March 2009.

Ministry of Commerce. 2009. http://www.mofcom.gov.cn/static/column/tongjiziliao/v.html/1. Accessed in March 2009.

NBS (National Bureau of Statistics). 2009a. China Statistical Yearbook, Beijing: China Statistics Press.

_____. 2009b. http://www.stats.gov.cn/tjsj/jidusj/

_____. 2009c. http://www.stats.gov.cn/was40/ gjtjj_detail.jsp?searchword=%C0%EE%CF%FE%B3%AC&channelid=6697&record=2.

_____. 2009d. http://www.stats.gov.cn/was40/gjtjj_detail.jsp?searchword=9%D4%C2%B7%DD&presearchword=%BE%C5%D4%C2%B7%DD&channelid=6697&record=2

_____. 2009e. http://www.stats.gov.cn/tjsj/

_____. 2009f. http://www.stats.gov.cn/was40/gjtjj_detail.jsp?searchword=%C5%A9%C3%F1%B9%A4&channelid=6697&record=45

_____. 2009g. http://www.stats.gov.cn/was40/gjtjj_detail.jsp?searchword=%C5%A9%C3%F1%B9%A4&channelid=6697&record=34

NDRC (National Development and Reform Commission). 2009. The Structure of Four Trillion Yuan Investment and The Latest Progress of Central Government Investment, in May 21,http://xwzx.ndrc.gov.cn/xwtt/t20090521_280373.htm

_____. 2008. The Central Government Investment Plan of new increased 100 billion yuan Was Implemented in December 12 http://xwzx.ndrc.gov.cn/xwtt/t20081218_ 252327.htm

Thurlow, J. 2004. Trade liberalization and poverty in South Africa: A computable general equilibrium and microsimulation analysis of past and potential trade policies. Ph. D dissertation, University of Natal, South Africa.

Wang, D., and C. Fang. 2009. The settlement of financial crisis on employment shocks. *Macroeconomics* (2): 16–22.

RECENT IFPRI DISCUSSION PAPERS

For earlier discussion papers, please go to www.ifpri.org/pubs/pubs.htm#dp.
All discussion papers can be downloaded free of charge.

978. *Emergence of Sri Lanka in European fish trade: Is there cause for concern in the Lake Victoria Region (East Africa)?* Andrew Muhammad and Guyslain Ngeleza, 2010.

977. *China has reached the Lewis Turning Point*. Xiaobo Zhang, Jin Yang, and Shenglin Wang, 2010.

976. *The medium-term impact of the primary education stipend in rural Bangladesh*. Bob Baulch, 2010.

975. *A review of empirical evidence on gender differences in nonland agricultural inputs, technology, and services in developing countries.* Amber Peterman, Julia Behrman, and Agnes Quisumbing, 2010.

974. *An experiment on the impact of weather shocks and insurance on risky investment.* Ruth Vargas Hill and Angelino Viceisza, 2010.

973. *Engendering agricultural research.* Ruth Meinzen-Dick, Agnes Quisumbing, Julia Behrman, Patricia Biermayr-Jenzano, Vicki Wilde, Marco Noordeloos, Catherine Ragasa, Nienke Beintema, 2010.

972. *Sarpanch Raj: Is the president all powerful? The case of village councils in India.* Nethra Palaniswamy, 2010.

971. Asset *versus consumption poverty and poverty dynamics in the presence of multiple equilibria in rural Ethiopia*. Lenis Saweda O. Liverpool and Alex Winter-Nelson, 2010.

970. *Poverty status and the impact of social networks on smallholder technology adoption in rural Ethiopia.* Lenis Saweda O. Liverpool and Alex Winter-Nelson, 2010.

969. *Wage subsidies to combat unemployment and poverty: Assessing South Africa's options*. Justine Burns, Lawrence Edwards, and Karl Pauw, 2010.

968. *Patterns and trends of child and maternal nutrition inequalities in Nigeria.* Babatunde Omilola, 2010.

967. *Foreign inflows and growth challenges for African countries: An intertemporal general equilibrium assessment.* Xinshen Diao and Clemens Breisinger, 2010.

966. *Biofuels and economic development in Tanzania.* Channing Arndt, Karl Pauw, and James Thurlow, 2010.

965. *Weathering the storm: Agricultural development, investment, and poverty in Africa following the recent food price crisis.* Babatunde Omilola and Melissa Lambert, 2010.

964. *Who has influence in multistakeholder governance systems? Using the net-map method to analyze social networking in watershed management in Northern Ghana.* Eva Schiffer, Frank Hartwich, and Mario Monge, 2010.

963. *How to overcome the governance challenges of implementing NREGA: Insights from Bihar using process-influence mapping.* Katharina Raabe, Regina Birner, Madhushree Sekher, K.G. Gayathridevi, Amrita Shilpi, and Eva Schiffer, 2010.

962. *Droughts and floods in Malawi: Assessing the economywide effects***.** Karl Pauw, James Thurlow, and Dirk van Seventer, 2010.

961. *Climate change implications for water resources in the Limpopo River Basin*. Tingju Zhu and Claudia Ringler , 2010.

960. *Hydro-economic modeling of climate change impacts in Ethiopia*. Gene Jiing-Yun You and Claudia Ringler, 2010.

959. P*romises and realities of community-based agricultural extension.* Gershon Feder, Jock R. Anderson, Regina Birner, and Klaus Deininger, 2010.

958. R*ethinking the global food crisis: The role of trade shocks*. Derek D. Headey, 2010.

957. F*emale participation in African agricultural research and higher education - New insights: Synthesis of the ASTI–award benchmarking survey on gender-disaggregated capacity indicators.* Nienke M. Beintema and Federica Di Marcantonio, 2010.

956. Short- *and long-term effects of the 1998 Bangladesh Flood on rural wages.* Valerie Mueller and Agnes Quisumbing, 2010.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

www.ifpri.org

IFPRI HEADQUARTERS
2033 K Street, NW
Washington, DC 20006-1002 USA
Tel.: +1-202-862-5600
Fax: +1-202-467-4439
Email: ifpri@cgiar.org

IFPRI ADDIS ABABA
P. O. Box 5689
Addis Ababa, Ethiopia
Tel.: +251 11 6463215
Fax: +251 11 6462927
Email: ifpri-addisababa@cgiar.org

IFPRI NEW DELHI
CG Block, NASC Complex, PUSA
New Delhi 110-012 India
Tel.: 91 11 2584-6565
Fax: 91 11 2584-8008 / 2584-6572
Email: ifpri-newdelhi@cgiar.org